Moody Air Force Base, Georgia

Grand Bay Range, Bemiss Field, and Moody Explosive Ordnance Disposal Range Operations

Final Environmental Assessment

June 2013

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14. ABSTRACT
The Air Force prepared this EA to assess current, emerging, and future training operations necessary to achieve and maintain readiness, and to upgrade/modernize existing range capabilities to enhance and sustain Air Force Training capabilities at Grand Bay Range, immediately adjacent to and east of Moody AFB in Lowndes and Lanier Counties, Georgia. Grand Bay Range supports targets and impact areas, Bemiss Field, and an EOD range. This EA analyzes the potential environmental impacts associated with increasing annual air-toground ordnance use during training, as well as to support to the maximum extent possible, other types of ground-based training using live fire for units stationed at Moody AFB. Under the Proposed Action alternatives, Moody AFB would continue to conduct air-to-ground operations as currently done by fixed- and rotary-wing aircrews from Moody AFB and transient users, but would increase the amount of ordnance fired on the Grand Bay Range Impact Area. In addition, ground-based operations would include live fire to support the 38 Rescue Squadron and 820 Base Defense Group squadron training requirements.

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FINDING OF NO SIGNIFICANT IMPACT

Environmental Assessment (EA) for Grand Bay Range, Bemiss Field, and Explosive Ordnance Disposal (EOD) Range Operations

INTRODUCTION

Pursuant to the Council on Environmental Quality's (CEQ's) regulations for implementing procedural provision of the National Environmental Policy Act (NEPA) (40 Code of Federal Regulations [CFR] 1500 to 1508) and 32 CFR 989, the United States (U.S.) Air Force (Air Force) has prepared an Environmental Assessment (EA) to assess current, emerging, and future training operations necessary to achieve and maintain readiness, and to upgrade/modernize existing range capabilities to enhance and sustain U.S. Air Force training capabilities at Grand Bay Range, immediately adjacent to and east of Moody Air Force Base (AFB), in Lowndes and Lanier Counties, Georgia. The EA is incorporated by reference into this Finding of No Significant Impact (FONSI).

PURPOSE AND NEED FOR THE PROPOSED ACTION

The purpose of the Proposed Action is to:

- Maintain pace with emerging and future air-to-ground training needs through continued upgrading and modernizing of Grand Bay Range's targets and impact areas as well as Bemiss Field;
- Sustain the primary mission of providing air-to-ground training opportunities and the long-term viability of Grand Bay Range, while at the same time protecting human health and the environment;
- Ensure continued ability to support current, emerging, and future EOD ground-based training operations at the Range;
- Offer air-to-ground training assets that meet advanced military technology, including new platforms and weapons systems; and
- Support, to the maximum extent possible, other types of ground-based training for units stationed at the base and other DoD users.

The Proposed Action is needed so that Grand Bay Range, Bemiss Field, and EOD range can maintain their overall strategic mission of supporting military combat readiness by providing a realistic, air-to-ground, live-training environment for aircrews and operational support personnel.

DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

The Proposed Action would provide increased ordnance use for air-to-ground training for the 23rd Fighter Group, 41st Rescue Squadron (RQS), and 71 RQS. It would also extend Grand Bay Range operating hours to support expanded ground-based training as needed. Typically, Grand Bay Range operates 17 hours per day Monday through Thursday, and 8.5 hours on Fridays (which includes a 4-hour maintenance period. Under the Proposed Action, the operating hours would be extended to accommodate 820th Base

Defense Group (BDG) operations during the night and on weekends after normal flying hours cease. However, extending range operating hours would only occur on an as needed basis. In the EA, two action alternatives and the no action alternative were analyzed.

Under Alternative 1 (Preferred Alternative), the Air Force would continue to conduct air-to-ground operations as currently done, but there would be increases in ordnance fired on the Grand Bay Range Impact Area. In addition, there would be a minor shift in the day-time versus nighttime split of operations. Specifically, this EA assumed that fixed-wing aircraft stationed at Moody AFB (A-10s) would conduct training 90 percent of the time during environmental day-time hours (7:00 a.m. and 10:00 p.m.) and the remaining 10 percent would be conducted during environmental nighttime hours (10:00 p.m. to 7:00 a.m.). For transient fixed-wing and rotary-wing aircraft, it was assumed 50 percent of the training would be conducted during environmental day-time hours and 50 percent of the training would be conducted during environmental nighttime hours. For rotary-wing aircraft stationed at Moody AFB, no change to the day-time/nighttime split was made; 40 percent of their operations currently occur during environmental daytime hours and 60 percent during environmental nighttime hours.

Under Alternative 2, air-to-ground training operations would be the same as described under Alternative 1. However, ground-based live ordnance use would increase above Alternative 1 to provide the 820 BDG with the capability for their three squadrons to complete annual initial qualification requirements, pre-deployment qualification requirements, and some proficiency fire, at Grand Bay Range and/or Bemiss Field. Under Alternative 2, the 820 BDG would continue to travel to Camp Blanding, FL or Fort Stewart, GA to complete remaining required proficiency training.

In addition to the two action alternatives, the No Action Alternative was analyzed. Under the No Action Alternative, current operations at Grand Bay Range Impact Area, Bemiss Field, and Moody EOD range (as summarized below) would be maintained. Under the No Action Alternative, the 820 BDG would continue to travel to either Camp Blanding or Fort Stewart to complete initial and pre-deployment qualification requirements and required proficiency training.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

NEPA and CEQ regulations, as well as Air Force procedures for implementing NEPA, specify that an EA should focus only on those resource areas potentially subject to impacts. In addition, the level of analysis applied to any given resource area should be commensurate with the level of impact anticipated for that resource. Initially, a total of 15 resource areas were identified as having a potential for impacts: 1) range management and operations; 2) noise; 3) hazardous and toxic materials and waste; 4) public health and safety; 5) recreation; 6) geological resources; 7) biological resources (including vegetation, wildlife, aquatic/wetland habitats, and sensitive species); 8) water resources (including surface and storm water, wetlands, ground water, and floodplains); 9) cultural resources; 10) air quality; 11) utilities; 12) transportation; 13) land use and visual resources; 14) socioeconomics; and 15) environmental justice and protection of children. Applying the guideline that the level of analysis should be commensurate with the level of impact anticipated, it was determined six of these resource areas, including air quality, utilities, transportation, land use and visual resources, socioeconomics, and environmental justice and protection of children, would not result in impacts; therefore, these resource areas were eliminated from detailed analysis in the EA. As summarized below, each of the resource areas assessed during the EA process would result in an impact that is less than significant.

Range Management and Operations: Range operations under Alternatives 1 and 2 would continue to be managed in accordance with the Grand Bay Comprehensive Range Plan. While scheduling would be more difficult under Alternative 2 due to the increase amount of ground-based operations, range operations would continue to be scheduled and training activities deconflicted in a manner that would ensure its safe, effective, and efficient operations in accordance with all applicable Air Force requirements.

Noise: While there would be an increase in noise levels generated by ground-based small arms operations under Alternatives 1 and 2, the increase would not be at such a level to introduce new incompatibilities with land use near the range. In addition, the human and/or natural environment would not be exposed to adverse health risks.

Hazardous and Toxic Materials and Waste: It is anticipated there would be a slight increase in the amount of hazardous materials used and hazardous waste generated under Alternatives 1 and 2. However, operations would continue to occur in accordance with existing procedures and permits.

Public Health and Safety: There would be no changes to ground safety procedures in regards to vehicle safety and wildland fire safety, and all ground activities would continue to be conducted using the same processes and procedures. New weapon danger zones ad surface danger zones have been generated for new ordnance proposed under Alternatives 1 and 2, and the Comprehensive Range Management Plan would be updated to reflect live fire being conducted at Grand Bay Range and Bemiss Field.

Recreation: Implementation of Alternatives 1 and 2 would result in more weekend closures; however, the Range would continue to work closely with the Georgia Department of Natural Resources to minimize the number of weekend days the Range would be closed for hunting.

Geological Resources: Under both Alternatives 1 and 2, Moody AFB would continue to comply with National Pollutant Discharge Elimination Systems permit and Georgia Erosion and Sediment Control Act regulations. Moody will also continue implementing BMPs such as maintaining vegetative buffers, streamside management zones, and other measures which would minimize the potential for soil erosion and sedimentation. An operational range assessment would be completed to assess the potential for off-range migration of munitions constituents from live fire during range operations.

Biological Resources: Approximately 3,496 acres of trees would fall under the new surface danger zones. Portions of these forested stands may become unsuitable for commercial timber harvest due to metal contamination or become vulnerable to pest infestation resulting in tree death. However, the forest would continue to be managed for the continued use and enhancement as detailed in the Installation’s Integrated Natural Resources Management Plan. Since Alternatives 1 and 2 would be implemented on an existing range, where the background noise and military activity levels are high, it is anticipated that wildlife present would generally be tolerant/acclimated to these noise and activity levels. Implementation of Alternatives 1 and 2 would have no effect on the eastern indigo snake and would not result in the incidental taking of bald eagles.

Water Resources: Moody AFB would continue to operate within all permitted guidelines, adhere to the Stormwater Pollution Prevention Plan, and conduct range operations in accordance with state and federal guidelines to ensure water quality was protected from possible impacts related to short- and long-term erosion and lead from spent munitions. This includes implementing project specific best management practices to minimize impacts to water quality. Depending on the manner in which ground operations occur, wetlands located on Grand Bay Range could be impacted by lead from expended casings. Site specific sampling would be required to determine whether lead is actually being transported in wetlands, potential minimization measures could be implemented to minimize adverse impacts to water quality.

Cultural Resources: No known architectural, traditional cultural resources, and/or sacred sites have been identified and implementation of Alternatives 1 or 2 would not result in ground disturbance. If any cultural or traditional resources were discovered at a target or training areas, operations would cease and discovery would be immediately reported to Moody AFB's cultural resource department.

PUBLIC AND AGENCY REVIEW PERIOD

The Draft EA and Draft FONSI were made available to the general public and applicable government agencies for review and comment during the 30-day period that commenced with publication of the Notice of Availability in the *Valdosta Daily Times* on 17 May 2013. Copies of these documents were available at the Valdosta Lowndes County Library, 300 Woodrow Drive, Valdosta, GA 31602 and were sent directly to applicable agencies for their review. Comments on the Draft EA were received from the Georgia Environmental Protection Division. These comments were addressed in the Final EA.

CONCLUSION

I conclude the environmental effects associated with the range operations at Grand Bay Range are not significant. Therefore, a FONSI is warranted, and preparation of an Environmental Impact Statement is unnecessary.

BDT

BILLY D. THOMPSON, Colonel, USAF
Commander, 23d Wing

24 Jun 13

Date

Cover Sheet

Environmental Assessment (EA) for Grand Bay Range, Bemiss Field, and Explosive Ordnance Disposal (EOD) Range Operations

Responsible Agency: United States Air Force (Air Force).

Affected Location: Moody Air Force Base (AFB), Georgia.

Report Designation: Final EA.

Abstract: The Air Force prepared this EA to assess current, emerging, and future training operations necessary to achieve and maintain readiness, and to upgrade/modernize existing range capabilities to enhance and sustain Air Force Training capabilities at Grand Bay Range, immediately adjacent to and east of Moody AFB in Lowndes and Lanier Counties, Georgia. Grand Bay Range supports targets and impact areas, Bemiss Field, and an EOD range.

This EA analyzes the potential environmental impacts associated with increasing annual air-to-ground ordnance use during training, as well as to support to the maximum extent possible, other types of ground-based training using live fire for units stationed at Moody AFB. Under the Proposed Action alternatives, Moody AFB would continue to conduct air-to-ground operations as currently done by fixed- and rotary-wing aircrews from Moody AFB and transient users, but would increase the amount of ordnance fired on the Grand Bay Range Impact Area. In addition, ground-based operations would include live fire to support the 38 Rescue Squadron and 820 Base Defense Group squadron training requirements.

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ACRONYMS AND ABBREVIATIONS

ACC	Air Combat Command
AETC	Air Education and Training Command
AFB	Air Force Base
AFI	Air Force Instruction
AFOSH	Air Force Occupational Safety and Health
AFSOC	Air Force Special Operations Command
AGL	above ground level
AGOW	Air Ground Operations Wing
AQCR	Air Quality Control Region
AR	Army Regulations
ATC	Air Traffic Control
BASH	Bird-Wildlife Aircraft Strike Hazard
BDG	Base Defense Group
BDU	bomb dummy unit
BMP	Best Management Practice
BRAC	Base Realignment and Closure
CAA	Clean Air Act
cal	caliber
CAU	Classic Associate Unit
CEQ	Council on Environmental Quality
CES	Civil Engineering Squadron
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2	carbon dioxide
CSAR	Combat Search and Rescue
CWA	Clean Water Act
dB	decibel
dBA	decibel, A-weighted
DC	District of Columbia
DNL	day-night average sound level
DoD	Department of Defense
DNR	Department of Natural Resources
DZ	drop zone
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
EOD	explosive ordnance disposal
EPCRA	Emergency Planning and Community Right-to-Know Act
ESA	Endangered Species Act
^{o}F	degrees Fahrenheit
FAA	Federal Aviation Administration
FL	Florida
ft	foot/feet
FG	Fighter Group
FONSI	Finding of No Significant Impacts
FONPA	Finding of No Practicable Alternative
FS	Fighter Squadron
FW	Fighter Wing
GA	Georgia
GBU	guided bomb unit
GHG	greenhouse gases
HZ	hertz
IED	Improvised Explosive Device
IICEP	Interagency and Intergovernmental Coordination for Environmental Planning
IR	infrared
JDAM	joint direct attack munitions
JTAC	joint terminal attack controller
LUPZ	Land Use Planning Zone
MAG	Marine Air Group
MAZ	Moody Activities Zoning District
mm	millimeter
MOA	Military Operations Area
MOUT	Military Operations Urban Terrain
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NAS	Naval Air Station
NEPA	National Environmental Policy Act
NHP	Natural Heritage Program
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NVG	night vision goggle
OSS	Operations Support Squadron
PJ	pararescuemen
PL	Public Law
R	Restricted (airspace)

RAPCON	Regional Airport Approach Control
RCO	Range Control Officer
RMTK	Range Managers Toolkit
ROD	Record of Decision
ROI	Region of Influence
RQG	Rescue Group
RQS	Rescue Squadron
SAM	surface-to-air missile
SARNAM	Small Arms Range Noise Assessment Model
SDZ	surface danger zone
SFG	Security Forces Group
SUA	special use airspace
SWPPP	Stormwater Pollution Prevention Plan
TFW	Tactical Fighter Wing
TP	training practice
ULZ	Unimproved Landing Zone
U.S.	United States
USACE	U.S. Army Corps of Engineers
USC	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGCRP	U.S. Global Change Research Program
UXO	unexploded ordnance
UV	ultraviolet
VA	Virginia
WG	Wing Group
WISS	Weapons Impact Scoring System

CHAPTER 1 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

1.1 INTRODUCTION

The United States (U.S.) Air Force (Air Force) has prepared this Environmental Assessment (EA) to assess current, emerging, and future training operations necessary to achieve and maintain readiness, and to upgrade/modernize existing range capabilities to enhance and sustain U.S. Air Force training capabilities at Grand Bay Range, immediately adjacent to and east of Moody Air Force Base (AFB), in Lowndes and Lanier Counties, Georgia (GA) (Figure 1-1). Grand Bay Range supports targets and impact areas, Bemiss Field, and an Explosive Ordnance Disposal (EOD) range (Figure 1-2). Unless specifically called out, Grand Bay Range refers to all of these training assets. Moody AFB owns and operates Grand Bay Range.

This Range is an important air-to-ground inert ordnance training facility used by the Air Force to fine-tune aircrew bombing, gunnery, electronic warfare, and air combat skills. Throughout this document, inert ordnance refers to non-explosive training ordnance that may contain a propellant or cartridge, which upon impact creates a smoke signature for scoring purposes. The Range is regularly used by fixed- and rotary-wing aircrews from Moody AFB, as well as other U.S. Air Force, Army, Navy, Marine Corps, and Air Guard installations from the southeast. Additionally, Air Force ground forces use the Range for a limited amount of ground-based training events. While this EA primarily addresses the potential impacts of Air Force training, actions of other services are also addressed.

As stated in Title 10 U.S. Code (USC) Section 8062, the Air Force is composed of the regular Air Force, Air National Guard, and Air Force Reserve. As directed by Congress, the Air Force mission is to: 1) preserve the peace and security, and provide for the defense of the United States, its Territories, Commonwealths, and possessions, and any areas occupied by the United States; 2) support the national policies; 3) implement the national objectives; and 4) overcome any nations responsible for aggressive acts that imperil the peace and security of the United States. To meet these directives, the Air Force must ensure that its personnel are trained and combat ready. Therefore, ranges and airspace must support training requirements that meet existing combat needs and those that are continually evolving.

The Proposed Action ensures that training opportunities at Grand Bay Range will meet current and evolving combat requirements for Moody AFB aircrews and personnel. Other Department of Defense (DoD) personnel may also be accommodated at the Range; however, use is granted only if the training does not conflict with the prime mission of providing air-to-ground training opportunities. The EA study area includes all of Grand Bay Range, Bemiss Field, and the EOD range, and focuses on the target infrastructure, impact areas, and overlying airspace used in air-to-ground training.

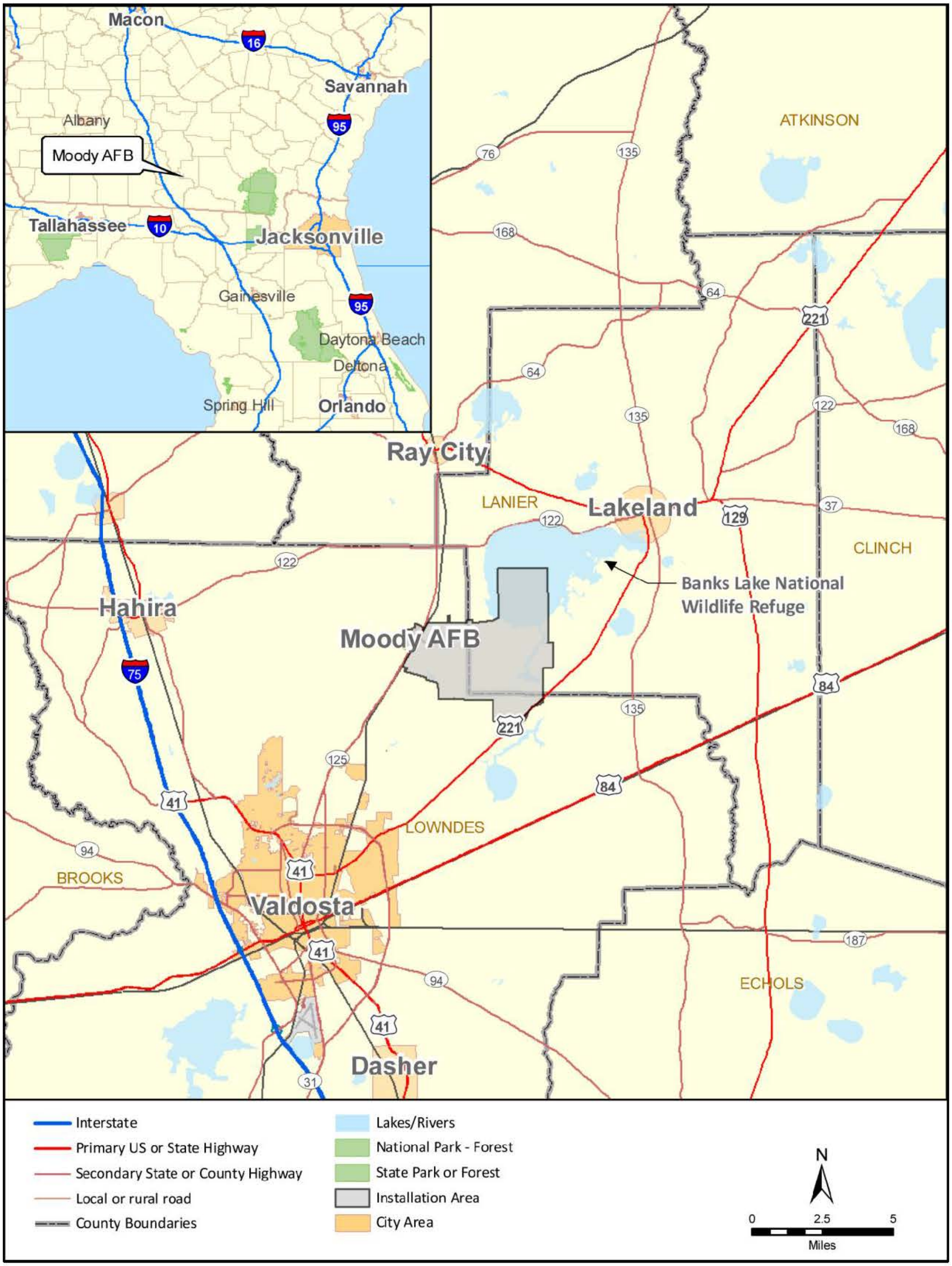

Figure 1-1. Grand Bay Range Vicinity Map

1.2 BACKGROUND

1.2.1 Historical Context

The Past. Military use of the Installation (which included Bemiss Field) began in early 1942 with the establishment of the Moody Field Advanced Pilot Training School. The Installation was closed in 1946 but was reopened permanently in 1951 to train pilots during the Korean conflict under the Air Training Command. Moody Field gained official permanent status as an AFB in 1954. Numerous force structure changes have occurred over the years. In the 1950s, the primary mission was to meet the requirements of the Air Force Pilot Instrument School and Instrument Flying School. Aircraft supporting that mission included the F-89 Scorpion, F-94 Starfire, and F-86 Sabre. The schools operated at Moody AFB until 1958 when they were moved to Texas. At that time, Moody AFB was aligned under the Air Training Command (later redesignated as Air Education and Training Command [AETC]) and was designated as a Pilot Training Wing. In 1975, Moody AFB was realigned under the Tactical Air Command and the 347th Tactical Fighter Wing (347 TFW) was activated as a host unit. In the same year, the 347 TFW began to transition from T-37 and T-38 aircraft to F-4E aircraft.

In 1985, Grand Bay Range was created when close to 5,900 acres were transferred from the U.S. Forest Service to Moody AFB (U.S. Air Force 1985). In 1987, the 347 TFW began converting from F-4s to F-16s. In 1991, the 347 TFW lost the “Tactical” designation and became the 347th Fighter Wing (347 FW), and in 1992 Moody AFB was assigned to Air Combat Command (ACC). In 1994, the Air Force added HC-130 and A/OA-10 (or A-10) aircraft, making Moody AFB one of three composite wings in the Air Force; in the same year, the 347 FW was redesignated the 347 Wing (WG) with F-16s, HC-130s, and A-10 aircraft.

In 1996, two Combat Search and Rescue (CSAR) squadrons of six HH-60 helicopters (41st Rescue Squadron [RQS]) and nine HC-130 air refueling aircraft (71 RQS) moved from Patrick AFB, Florida, to Moody AFB. This realignment of geographically separated units reduced manpower requirements, placed the affected units under a single commander, and improved deployment in support of the ACC mission (U.S. Air Force 1996).

In September 1998, per Quadrennial Defense Review recommendations, the 41 RQS was assigned an additional six HH-60 aircraft (U.S. Air Force 1998). At the same time, the decision was made to deactivate the 70th Fighter Squadron (70 FS) and relocate the 24 assigned A/OA-10 aircraft to other locations. In addition, an Introduction to Fighter Fundamentals pilot training program was established with 57 T-38 aircraft (U.S. Air Force 1998). In 2000, in an effort to streamline FS operations, the Air Force deactivated the 68 FS and 69 FS which relocated 36 F-16 aircraft to other locations (U.S. Air Force 1999). In 2001, a Joint Primary Pilot Training course, under AETC, was established at Moody AFB and with it came 49 T-6As, and 10 additional T-38s. Also in 2001, the 820th Security Forces Group (later redesignated in 2010 as the 820th Base Defense Group [BDG]) became a tenant unit at Moody AFB; while no aircraft are associated with this group, they require integrated training with the HC-130s and

HH-60s for paradropping (U.S. Air Force 2000a). In 2003, the base was once more realigned to the Air Force Special Operations Command (AFSOC) and remained under this command until 2005.

In 2006, in response to Base Realignment and Closure (BRAC) decisions, Moody AFB was realigned from AFSOC back to ACC. As a result, all T-38C and T-6A aircraft were relocated from Moody AFB to other AETC units. In their place, Moody AFB again was home to 48 A-10 aircraft (U.S. Air Force 2006). In 2008, the Air Force established an Unimproved Landing Zone (ULZ) at Bemiss Field for CSAR units at Moody AFB to meet ULZ qualification training and night vision goggle (NVG) air/land training. In addition, CSAR units would also train in mass casualty evacuation; insertion, extraction, and transload of pararescuemen (PJ); and extraction of survivors (U.S. Air Force 2008a). In 2008, a third squadron of Air Force Reserve Command Classic Associate Unit (CAU) (476th Air Force Reserve Fighter Group [FG]) A-10s was approved to operate and maintain aircraft at Moody AFB (U.S. Air Force 2008b).

The Present. Moody AFB is home to the 23rd Wing Group (23 WG), which consists of six groups: the 23rd Mission Support Group, 23rd Medical Group, 23rd Maintenance Group, 23rd FG, 347th Rescue Group (RQG), and 563 RQG. The 23 WG executes worldwide close air support, force protection, and rescue forces to include CSAR (or personnel recovery) and operations in support of humanitarian interests, U.S. national security, and the global war on terrorism. The overall mission of 23 WG is to organize, train, and employ combat-ready A-10C Thunderbolt II, HH-60G Pave Hawk, and HC-130P Combat King aircraft; PJ; force protection assets; and 6,100 military and civilian personnel (Moody AFB 2011a, b). Tenant units include the 93rd Air Ground Operations Wing (AGOW), 820 BDG, 476 Air Force Reserve FG, 336th Recruiting Squadron, 372nd Training Squadron—Detachment 9, Area Defense Counsel, and Air Force Office of Special Investigations—Detachment 211.

As the operating entity, Moody AFB is responsible for all land management, including natural and cultural resources, EOD, and other land management issues on Grand Bay Range. The 23 Fighter Group (FG) provides management and maintenance for the Range. However, as part of the overall natural resources management, the Georgia Department of Natural Resources (GA DNR) implements a fish and wildlife management program at Grand Bay Range under an Air Force license agreement. To the south of Moody AFB, Grand Bay Range is combined with state-owned and state-leased property to form the Grand Bay Wildlife Management Area (Moody AFB 2007a).

1.2.2 Training

Grand Bay Range primarily supports training by 23 WG aircrew and personnel, and secondarily supports 23 WG ground personnel and tenant units. Training refers to the acquisition of knowledge, skills, and competencies as a result of vocational and practical training. In the military context, it means gaining the physical skills, ability, and knowledge to perform and survive in combat. It includes basic military, skill-specific, and weapons-specific training (both hardware and tactical), as well as formal education. It builds proficiency, cohesion, and teamwork and is fundamental to achieving unity of effort. Training is the primary means for maintaining, improving, and evaluating the Air Forces' readiness to fight and win.

The key to combat effectiveness is realistic training. "Train As We Fight" is a statement of the necessity to realistically train for the conditions that may occur in combat. Realistic training supplements limited combat experience. Combat is a time of intense chaos where panic and fear can easily overcome self-discipline and focus. Intensive, repetitive, and realistic training exercises which replicate the stress, discomfort, and physical conditions of combat provide the best means of preparing forces and generating confidence in (and knowledge of) plans, tactics, and procedures. Air Force training proceeds on a continuum, from teaching of basic and specialized individual military skills, to intermediate skills or small unit training, to advanced, integrated training events, and culminates in joint exercises or pre-deployment certification events. Each step on this continuum is assessed for effectiveness on an ongoing basis, as new systems or tactics, techniques, and procedures are developed and implemented. Therefore, to meet these training needs, assets (inclusive of ranges and airspace) have to offer the capabilities airmen, pilots, and aircrews need to maintain their mission readiness at all times. Training requirements, therefore, are the primary drivers for determining the optimal configuration and assets offered on Grand Bay Range.

The following organizations are key users of Grand Bay Range and/or Bemiss Field; a description of their specific missions and the type of training they conduct immediately follows:

- 23 FG with two A-10 squadrons—the 74 and 75 FS;
- 476 FG, an A-10 Air Force Reserve unit;
- 347 RQG with one squadron of HC-130P aircraft—71 RQS, one squadron of HH-60s—41 RQS; and one squadron of Guardian Angel Weapon System—38 RQS; and
- 820 BDG and 93 AGOW (Moody AFB 2011b).

23 FG

The 23 FG directs the flying and maintenance operations for the Air Force's largest A-10C fighter group, consisting of two combat-ready A-10C squadrons (the 74 and 75 FS) and an operations support squadron. The Group ensures overall combat training and readiness for over 90 pilots and 300 support personnel (Moody AFB 2011c).

476 FG

As an associated unit of the 23 FG, this Air Force Reserve squadron works under its own command structure but integrates its A-10 operations with the 74 and 75 FS. By 2012, this group should complete their basing at Moody AFB and have the 76 FS fully operational (Air Force Historical Research Agency 2011).

347 RQG

The 347 RQG directs flying and maintenance of the oldest U.S. Air Force active duty operations group dedicated to combat search and rescue. Members assigned to the 347 RQG are responsible for training/readiness of 540 personnel, including a Guardian Angel squadron, two flying squadrons (HC-130P and HH-60) and an operations support squadron. The group also deploys worldwide in support of requests from the National Command Authority. There are four squadrons aligned within the group: 38 RQS, 41 RQS, 71 RQS, and 347 Operations Support Squadron (OSS) (Moody AFB 2011d).

38 RQS. This squadron maintains combat-ready status as a Guardian Angel rescue squadron. It trains, equips, and employs combat rescue officers, pararescue, survival, evasion, resistance, and escape specialists and supporting personnel worldwide in support of U.S. national security interests and National Aeronautics and Space Administration activities. Its members accomplish all five execution tasks of Personnel Recovery, specializing in survivor contact, treatment, and extraction in denied, uncertain, and hostile territories.

41 RQS. This squadron has a wartime mission to conduct day/night and adverse weather long range, personnel recovery operations; penetrating into contested/sensitive environments; and non-combatant evacuation operations. The mission includes low-level operations, air refueling, alternate insertion and extraction, and hot refueling operations.

71 RQS. This Squadron maintains combat-ready status with 10 HC-130P aircraft. They provide rapidly deployable personnel and recovery forces to theater commanders for worldwide contingency and crisis response operations. The 71 RQS specializes in the rescue of isolated personnel from austere, denied objectives.

347 OSS. This squadron directs operational support functions including current operations, intelligence, training weapons and tactics, aircrew flight equipment, simulation, medical, mobility, flying hour program management, and Host Aviation Resource Management. The 347 OSS supports the 23 FG and tenant mobility training requirements and implements contingency and theatre war plans.

93 AGOW

The 93 AGOW conducts worldwide offensive and defensive ground combat operations to protect expeditionary aerospace forces with an airborne capability. The Wing provides joint force commanders with air control party personnel, battlefield weather support, and force protection assets (Moody AFB 2011e).

820 BDG

Aligned under the 93 AGOW, the 820 BDG was activated in 1997. It represents an exceptionally trained force protection unit of 12 Air Force Specialty Codes with an airborne capability. At a moment's notice, the group provides the expeditionary Air Force's only worldwide deployable, "first-in", fully integrated, multi-disciplined, highly qualified, self-sustaining force protection capability. Within the 820 BDG are the 820th Combat Operations Squadron, and the 822nd, 823rd, and 824th Base Defense Squadrons (Moody AFB 2011f).

1.3 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

The Proposed Action has been developed to provide combat capable aircrews, ready to deploy worldwide in accordance with USC Title 10 Section 8062. Specifically, the purpose of the Proposed Action is to:

- Maintain pace with emerging and future air-to-ground training needs through continued upgrading and modernizing of Grand Bay Range's targets and impact areas as well as Bemiss Field;
- Sustain the primary mission of providing air-to-ground training opportunities and the long-term viability of Grand Bay Range, while at the same time protecting human health and the environment;
- Ensure continued ability to support current, emerging, and future EOD ground-based training operations at the Range;
- Offer air-to-ground training assets that meet advanced military technology, including new platforms and weapons systems; and
- Support, to the maximum extent possible, other types of ground-based training for units stationed at the base and other DoD users.

The Air Force needs the Proposed Action so that Grand Bay Range, Bemiss Field, and EOD range can maintain their overall strategic mission of supporting military combat readiness by providing a realistic, air-to-ground, live-training environment for aircrews and operational support personnel.

1.4 Environmental Review Process

1.4.1 National Environmental Policy Act (NEPA)

NEPA requires consideration of environmental issues in federal agency planning and decision making. Under NEPA, federal agencies must prepare an EA or Environmental Impact Statement (EIS) for any major federal action, except those actions that are determined to be "categorically excluded" from further analysis. An EA is a concise public document that provides sufficient analysis for determining whether the potential environmental impacts of a Proposed Action are not significant, resulting in the preparation of a Finding of No Significant Impact (FONSI), or significant, resulting in the preparation of an EIS.

1.4.2 Scoping and Alternatives Development

Scoping is an early and open process for developing the breadth of issues to be addressed in the EA and for identifying significant concerns related to a Proposed Action. Through the Interagency and Intergovernmental Coordination for Environmental Planning (IICEP) process, the Air Force notified relevant federal, state, and local agencies, and allowed them sufficient time to evaluate and comment on the proposal. Comments from these agencies were addressed and subsequently incorporated into the environmental impact analysis process pursuant to Air Force Instruction (AFI) 32-7060, *Interagency and Intergovernmental Coordination for Environmental Planning*, and 32 Code of Federal Regulations (CFR) 989.14(l) (see Appendix A for mailing list and agency correspondence). For Proposed Action and alternatives development, questionnaires were distributed to range operators and units that use Grand Bay Range, Bemiss Field, and EOD range to collect data on operational requirements, and for use as a guide in developing a reasonable range of alternatives best meeting the purpose and need. This process focused primarily on options that best met current and emerging training requirements for Moody AFB units. Although training operations for tenant and non-Air Force users were considered, they did not drive n or dictate the Proposed Action or alternatives. Specifically, this EA evaluates and assesses Grand Bay Range infrastructure and facilities and their ability to meet existing and emerging Air Force training requirements; the Proposed Action does not include any new or modified airspace units or land acquisitions.

1.4.3 Documents Incorporated by Reference

In accordance with Council on Environmental Quality (CEQ) regulations for implementing NEPA and with the intent of reducing the size of this document, the following material (ordered by date) relevant to the Proposed Action is being incorporated by reference. Actions related to training operations at Grand Bay Range, Bemiss Field and the EOD range have been included into the environmental analysis of this EA.

- EIS, Winnersville Weapons Range, Tactical Air Command, Langley AFB, Virginia (VA). Record of Decision (ROD) signed March 1986. The EIS evaluated the potential impacts from constructing and operating what would become Grand Bay Range (U.S. Air Force 1985).
- EA, C-130 Drop Zone for Moody AFB, GA. U.S. Air Force, Washington, District of Columbia (DC). FONSI signed December 1995. This action established a Drop Zone (DZ) at Bemiss Field and initiated use of the Main Bomb Site on Grand Bay Range as a Limited DZ (U.S. Air Force 1995).
- EA, Relocation of the 41 and 71RQS to Moody AFB, GA. FONSI signed July 1996. This action consolidated HH-60 and C-130 rescue squadron aircraft from Patrick AFB to Moody AFB (U.S. Air Force 1996).
- EA, Force Structure Actions at Moody AFB, GA. FONSI signed September 1998. This action added 6 more HH-60 helicopters to augment the existing inventory, deactivated the 70 FS, and relocated A-10 aircraft to other bases (U.S. Air Force 1998).
- EA, F-16 Drawdown at Moody AFB, GA. FONSI signed September 1999. This EA evaluated the effects of deactivating the 68 FS and 69 FS and relocating 36 F-16 aircraft to other bases (U.S. Air Force 1999).
- EA, 820 Security Forces Group (SFG) Beddown at Moody AFB, GA. FONSI signed February 2000. Evaluated impacts of basing the 820 SFG (later becoming the 820 BDG) at Moody AFB, and associated facility renovations and minor construction along the proposed field training activities at Camp Blanding, Florida and Fort Stewart, Georgia (U.S. Air Force 2000a).
- EA, Joint Primary Aircraft Training System T-6A Beddown at Moody AFB, GA. ACC, Langley AFB, VA. FONSI signed March 2000. This action established T-6A and additional T-38 aircraft at Moody AFB (U.S. Air Force 2000b).
- EA, BRAC A/OA-10 Beddown at Moody AFB, GA. ACC, Langley AFB, VA. FONSI signed September 2006. Removed T-6A and T-38 aircraft and replaced with A-10 aircraft—realigned from an AETC to an ACC base (U.S. Air Force 2006).
- EA, BRAC relocation of Marine Aircraft Group (MAG)-42 (including its subunits Marine Light Helicopter Squadron-773 and Marine Aviation Logistics Squadron-42) to Robins AFB from Naval Air Station (NAS) Atlanta, GA. FONSI/FONPA (Finding of No Practicable Alternative) signed

September 2007. Due to NAS Atlanta's closure, the Marine helicopters (now based at Robins AFB) conduct air operations training at Robins AFB as well as at Fort Benning's Lawson Army Airfield in Columbus, GA and live-fire training at Fort Stewart in Hinesville, GA. Occasionally, the helicopters conduct training at Grand Bay Range; however, only when scheduling permits such use (U.S. Air Force 2007).

- EA, Bemiss Field ULZ and AC-130 Operations at Grand Bay Range, GA. Moody AFB, GA. FONSI signed in October 2008 for ULZ construction only. This EA evaluated impacts of AC-130 aircrews conducting more of their training at Grand Bay Range rather than at remote ranges (U.S. Air Force 2008a).
- EA, Beddown of Air Force Reserve Command CAU for A/OA-10 Operations and Maintenance at Moody AFB, GA. FONSI Signed September 2008. This action integrated an Air Force Reserve CAU of A-10s with active-duty A-10s already based at Moody AFB. Introduced requirement for this CAU to train one weekend per month at Grand Bay Range (U.S. Air Force 2008b).
- EA, Expansion of Sortie-Operations at Moody AFB, GA. This action would increase training opportunities with the aircraft stationed at Moody AFB by increasing sortie-operations from 37,158 annual sortie operations to 52,426 annual sortie operations. In addition, the action proposes the use of flares at Moody AFB, as well as increase the expenditure of ordnance at Townsend Range U.S. Air Force 2012. The proposed action in the Sortie-Operations EA does not include an increase in use of live ordnance, which is addressed in this EA; however, it is anticipated that the increase in sortie-operations would be sufficient to accommodate any proposed increase in ordnance as analyzed in this EA (U.S. Air Force 2012).

1.4.4 Decision to be Made

Based on the analysis in this EA, the Air Force will make one of three decisions regarding the Proposed Action:

1) choose the Proposed Action or alternative and sign a FONSI, allowing implementation of the Proposed action or alternative;
2) initiate preparation of an EIS if it is determined that significant impacts would occur with implementation of the Proposed Action or alternative; or
3) select the No-Action Alternative, whereby the Proposed Action or alternative would not be implemented.

1.4.5 Agency and Public Involvement

The Draft EA and Draft FONSI were made available to the general public and applicable government agencies for review and comment during the 30-day period that commenced with publication of the Notice of Availability in the *Valdosta Daily Times* on 17 May 2013. Copies of these documents were available at the Valdosta Lowndes County Library, 300 Woodrow Drive, Valdosta, GA 31602 and were sent directly to applicable agencies for their review. Comments on the Draft EA were received from the

Georgia Environmental Protection Division. These comments are included in Appendix A and addressed in this Final EA.

1.5 REGULATORY COMPLIANCE

In accordance with CEQ NEPA regulations and where applicable, the Air Force has prepared this EA concurrently with other environmental laws, regulations, and Executive Orders (EOs) outlined by environmental resources listed in Table 1-1.

Table 1-1. Major Federal Environmental Statutes, Regulations, and Executive Orders Applicable to Federal Projects

Environmental Resources	*Statute, Regulation, or Executive Order*
Air Quality	Clean Air Act (CAA) of 1970 (Public Law [PL] 95-95), as amended in 1977 and 1990 (PL 91-604); U.S. Environmental Protection Agency (USEPA), Subchapter C-Air Programs (40 CFR Parts 52-99); and 40 CFR Part 63, National Emissions Standards for Hazardous Air Pollutants.
Noise	Noise Control Act of 1972 (PL 92-574) and Amendments of 1978 (PL 95-609); and USEPA, Subchapter G, Noise Abatement Programs (40 CFR Parts 201-211).
Geology and Soils	National Pollutant Discharge Elimination System (NPDES) Construction Activity General Permit (40 CFR Parts 122-124).
Water Resources	Federal Water Pollution Control Act of 1972 (PL 92-500) and Amendments; Clean Water Act (CWA) of 1977 (PL 95-217); NPDES Construction Activity General Permit (40 CFR Parts 122-124); NPDES Industrial Permit and NPDES Municipal Separate Storm Sewer System Permit; CWA 40 CFR 112 Spill Prevention Control and Countermeasure; USEPA, Subchapter D-Water Programs (40 CFR Parts 100-145); Water Quality Act of 1987 (PL 100-4); USEPA, Subchapter N-Effluent Guidelines and Standards (40 CFR Parts 401-471); Safe Drinking Water Act of 1972 (PL 95-923) and Amendments of 1986 (PL 99-339); and USEPA, National Drinking Water Regulations and Underground Injection Control Program (40 CFR Parts 141-149).
Biological Resources	Migratory Bird Treaty Act of 1918; Fish and Wildlife Coordination Act of 1958 (PL 85-654); Sikes Act of 1960 (PL 86-97) and Amendments of 1986 (PL 99-561) and 1997 (PL 105-85 Title XXIX); Endangered Species Act (ESA) of 1973 (PL 93-205) and Amendments of 1988 (PL 100-478); Fish and Wildlife Conservation Act of 1980 (PL 96-366); Lacey Act Amendments of 1981 (PL 97-79); and Responsibilities of Federal Agencies to Protect Migratory Birds (Executive Order [EO] 13186).
Wetlands and Floodplains	Section 401 and 404 of the Federal Water Pollution Control Act of 1972 (PL 92-500); USEPA, Subchapter D, Water Programs 40 CFR Parts 100-149 (105 ref); Floodplain Management-1977 (EO 11988); Protection of Wetlands-1977 (EO 11990); Emergency Wetlands Resources Act of 1986 (PL 99-645); and North American Wetlands Conservation Act of 1989 (PL 101-233).
Cultural Resources	National Historic Preservation Act (16 USC 470 *et seq.*) (PL 89-865) as amended; Protection and Enhancement of the Cultural Environment-1971 (EO 11593); Indian Sacred Sites-1966 (EO 13007); American Indian Religious Freedom Act of 1978 (PL 94-341); Antiquities Act of 1906; American Indian Religious Freedom Act of 1979 (PL 96-95); Native American Graves Protection and Repatriation Act of 1990 (PL 101-601); Protection of Historic Properties (36 CFR 800); Preserve America (EO 13287); and Archeological Resources Protection Act (PL 96-95; 16 USC 470).

Table 1-1. Major Federal Environmental Statutes, Regulations, and Executive Orders Applicable to Federal Projects

Environmental Resources	*Statute, Regulation, or Executive Order*
Hazardous and Toxic Substances and Waste	Resource Conservation and Recovery Act of 1976 (PL 94-5800), as Amended by PL 100-582; USEPA, subchapter I-Solid Wastes (40 CFR Parts 240-280); Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 USC 9601) (PL 96-510); Toxic Substances Control Act (PL 94-496); USEPA, Subchapter R-Toxic Substances Control Act (40 CFR Parts 702-799); Federal Insecticide, Fungicide, and Rodenticide Control Act (40 CFR Parts 162-180); Emergency Planning and Community Right-to-Know Act (40 CFR Parts 300-399); Federal Compliance with Pollution Control Standards-1978 (EO 12088), Superfund Implementation (EO 12580); Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition (EO 13101); Greening the Government Through Efficient Energy Management (EO 13123); and Greening the Government Through Leadership in Environmental Management (EO 13148).
Socioeconomics	Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations (EO 12898); and Protection of Children from Environmental Health Risks and Safety Risks (EO 13045).

1.6 Scope and Organization of the Environmental Assessment

The geographic scope of this EA is primarily found within Grand Bay Range boundaries (including Bemiss Field and EOD range). However, the region of influence (ROI) for some resource areas includes a larger geographic area. The specific ROI (or affected environment) for each resource is identified in Chapter 3. The resource categories determined relevant to this assessment include soil resources, water resources, air quality, noise, biological resources, recreation, hazardous materials and waste, cultural resources, and safety. Justification for not evaluating other resources is presented in Chapter 3 of this EA. To summarize, Chapter 1 (this chapter) provides background information relevant to the Proposed Action and discusses its purpose and need. Chapter 2 presents the Proposed Action, alternative action, No-Action Alternative, alternatives eliminated from detailed consideration, and a comparison of the alternatives. Chapter 3 outlines and justifies resources evaluated in this EA, describes baseline conditions (i.e., the conditions against which the potential impacts of the Proposed Action or alternatives are measured) for each of the resource areas, as well as identifies the specific ROI or affected environment for the resource. The potential environmental impacts/consequences of the Proposed Action and alternatives are also presented in Chapter 3. In Chapter 4, analysis of cumulative effects is presented. Potential cumulative effects include evaluation of the Proposed Action (and alternatives) in relation to past, present, and/or future foreseeable actions within the ROI or affected environment. Other types of impacts, i.e., relationship between local short-term uses of the environment and enhancement of long-term productivity; irreversible or irretrievable commitment of resources; and energy requirements, are presented in Chapter 5. Chapter 6 contains references cited in preparation of this EA, including correspondence. Chapter 7 provides a list of EA preparers.

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CHAPTER 2 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

As discussed previously, the purpose of the Proposed Action is to ensure that Grand Bay Range (inclusive of Bemiss Field and EOD range) continues to support current, emerging, and future training operations necessary to achieve and maintain readiness. To do this, the Air Force needs to continually upgrade/modernize existing range capabilities to enhance and sustain readiness training at Grand Bay Range. This chapter provides detailed information on the Proposed Action and alternatives analyzed in this EA. Section 2.1 provides a detailed description of the Range and Section 2.2 describes the major elements of the Proposed Action and presents alternatives to the Proposed Action including the No Action Alternative.

2.1 GRAND BAY RANGE USERS AND TRAINING OPERATIONS

The following sections provide short summaries of the units that operate on the Range and associated training lands and the type of training they need to maintain combat readiness. These summaries are not exhaustive but provide a good, general overview of the type of training each unit conducts. The following is arranged first by squadrons that have flying missions followed by squadrons that are transported by aircraft to accomplish their primarily ground-based missions.

2.1.1 23 FG (74 and 75 FS) and 476 FG

The three A-10 fighter squadrons have similar training range needs that include both day and night operations for tactical weapons delivery and surface attack tactics. Tactical weapons delivery exposes the pilot to varying visual cues, shadow patterns, as well as target configuration and appearance. In surface attack tactics the pilot engages with ground-based threats (e.g., simulated anti-aircraft artillery) using defensive countermeasures such as chaff and/or flares, targets and "destroys" the threat(s), and then safely exits the threats to reform with the fighter group (U.S. Air Force 2006). In addition, the LUU-2 (a particular type of flare) is used to illuminate targets to enhance pilot vision when wearing night vision goggles (NVGs). These 30-pound flares are parachuted over the target area and remain ignited for about 5 minutes (Global Security 2011). Training activities for the three A-10 squadrons include (but are not limited to) the following:

- Targeting Training—bombing, gunnery, tactical deliveries (any direction, altitude, and maneuver within R3008 A-D), conventional deliveries, low/medium/high altitude deliveries, combat lasers, and combat search and rescue events;
- Operations Training—close air support, low/medium/high altitude operations, and tactical response to radar and missile threats (any maneuver and direction); and
- Weapons/Ammunition/Ordnance—inert and training 2.75 inch rockets, 30 millimeter (mm), bomb dummy unit (BDU)-33s (or equivalent), heavy weight inert bombs up to 2,000 pounds, LUU-2, flares, chaff, as well as inert joint direct attack munitions (JDAM) or inert bomb units guided by geographic positioning systems and laser-guided weapons.

Currently, the three A-10 squadrons comprise the majority of operations at the Grand Bay Range impact areas. When the A-10s and HH-60s conduct bombing and gunnery training, Bemiss Field is basically closed to any ground-based training activities to ensure the safety of all individuals.

2.1.2 71 RQS

This squadron maintains combat-ready HC-130P aircraft and associated aircrews and maintainers to conduct personnel recovery missions at a moment's notice, anywhere in the world. To do this the squadron needs to conduct low/medium/high altitude operations, undertake nighttime aerial refueling with NVGs, and airdrop pararescue personnel. Training activities of the 71 RQS include but are not limited to:

- Operations Training—aircraft flight training for container and bundle deliveries; airdrop training for various types of day and nighttime missions (combat, personnel rescue); aircraft container/bundle deployment via lines, parachutes, and freefall; personnel drops (static line and high-altitude, low opening training); defensive maneuver and reaction training with ground party and emitters; aerial refueling; ULZ qualification training; NVG air/land training; mass casualty evacuation; insertion, extraction, and loading of pararescuemen; and extraction of survivors.
- Weapons/Ammunition/Ordnance—defensive countermeasure training in chaff and flares at any direction, altitude, and maneuver within R3008 A-D.

At Grand Bay Range, including Bemiss Field, the 71 RQS conducts airdrops of standard training bundles and containers at the drop zones and practices electronic warfare and defensive countermeasures with threat emitters and smokey surface-to-air missile (SAMs) (a small unguided rocket used to visually simulate a surface-to-air missile). The 71 RQS conducts operations concurrently with the 38 RQS. On Bemiss Field, personnel and equipment airdrops are done depending on Range scheduling. The squadron spends about 194 hours per year at the Range and Bemiss Field (Morgan 2011).

2.1.3 41 RQS

This personnel recovery squadron maintains combat-ready HH-60 Pave Hawk aircraft. Aircraft need to be maintained and aircrews ready to deploy at a moment's notice, to anywhere in the world. They specialize in combat rescue of downed aircrews, nighttime operations/extractions, and low altitude maneuvering. To maintain combat readiness the squadron conducts:

- Operations Training—helicopter flight training for personnel recovery operations during the day, at night (i.e., with night vision goggles), and in combat; takeoff and landing in mountainous terrain and black-out/brown-out situations; electronic warfare engagement; formation flight; insertions/extractions with ropes, ladders, hoists, and rappelling; and defensive countermeasures deployment. In conjunction with ground forces, the squadron conducts call for fire, military operations urban terrain (MOUT), and laser operations.
- Weapons/Ammunition/Ordnance Use—Chaff, flares, and training/inert 7.62 mm and .50 caliber (cal) munitions at any direction, altitude, and maneuver within R3008 A-D.

Currently, the squadron trains at .50 cal and 7.62 mm targets (static and moving) for aerial gunnery proficiency, qualification, and currency. Range use typically occurs Monday through Thursday, two sessions a day, at a minimum of about 2 hours during the day and 3 to 4 hours at night (depending on the season, nighttime operations can run anytime between 1900 to 0200 hours [7:00 p.m. and 2:00 a.m.]). The HH-60s operate on the Range for landing, alternate insertion and extraction, and hovering proficiency, qualification, and currency to include the slope landing area, MOUT, brown-out pit, and flight deck landing procedures.

Operations include flare employment in response to smokey SAMs, as well as chaff for defensive countermeasures. The squadron uses Bemiss Field for landing, alternate insertion and extraction, and hovering proficiency. Two larger hover holes and seven smaller hover holes, located adjacent to Bemiss Field, provide confined landing and hovering training. Occasionally, both the Range and Bemiss Field are used simultaneously to facilitate training of two independent helicopters (working different learning objectives) and provide for enough space for safe separation between the two (Dugan 2011; Shonkwiler 2011).

2.1.4 38 RQS

The 38 RQS trains, equips, and deploys pararescue and support personnel worldwide for U.S. national security interests and humanitarian operations. This squadron specializes in combat rescue, survivor contact, treatment, and extraction in austere, denied, and hostile territories. Training takes place day and night focusing on the skills needed to meet their mission and include:

- Operations Training—ground and survival maneuvers; call for fire; improvised explosive devices (IEDs), convoy, and all-terrain vehicle training; as well as target marking.
- Weapons/Ammunition/Ordnance –inert/training M-16 and M-4 with 5.56 mm tracer rounds, 9 mm rounds, smoke grenades, blast simulators, and simunitions (i.e., training ammunition simulating realistic handling and recoil for most types of firearms such as 40 mm training grenades).

Currently the 38 RQS uses Grand Bay Range and Bemiss Field an average of 10 days per year for independent training. Occasionally, the 38 RQS will conduct helicopter training with the 41 RQS (Sferrazza 2011).

2.1.5 23 CES/CED (EOD Flight)

The EOD Flight is responsible for range surface decontamination and provides the primary emergency response capability to incidents/accidents involving ordnance and improvised explosive devices. The EOD mission is to render safe, remove, and dispose of U.S. and foreign conventional, incendiary, chemical, biological, and nuclear ordnance, as well as criminal and terrorist devices and weapons of mass destruction. The EOD Flight provides direct support to federal, state, and local law enforcement concerning EOD matters in the interest of public safety.

- Operations Training—EOD range Site 1 is used every other week for training purposes. Targets range from dirt, metal/plastic, munitions, vehicles, and miscellaneous equipment. Training munitions used include Hazard/Class Division 1.1 high explosives to Hazard/Class Division 1.4 small arms ammunition and low explosives. Grand Bay Range impact area is used for the destruction of ordnance cleared during range clearances.

- Ammunition/Ordnance Use—EOD ordnance include but are not limited to M112 Comp 4, detonating cord, TNT, M6 electric blasting caps, specialty 12 gauge loads, shock tube, M7 non-electric blasting caps, M18 smoke grenades, thermite grenades, inert/training improvised explosive devices, and military ordnance items (Schmidt 2011).

2.1.6 93 AGOW

The 93 AGOW is composed of highly trained ground combat forces who conduct worldwide offensive and defensive operations by integrating air and space power with ground fire and maneuvering. To maintain this level of capability this wing conducts:

- Operations Training—maintain proficiency and upgrade their joint terminal attack controller (JTAC) experience, where Wing members operate from a forward position, directing the action of aircraft engaged in close air support and other offensive air operations; convoy and IED delivery training; operating small to medium unmanned aerial systems; joint fire officer training and proficiency; ground maneuvering and ground laser use; integrated participation in aerial training exercises; paradrops and personnel drops; and airfield seizures.
- Weapons/Ammunition/Ordnance Use—inert/training rounds of 7.62 mm (for rifles), 5.56 mm, and .50 cal (for machine gun use).

Currently, the 93 AGOW uses the Range during the day and night for JTAC training primarily with A-10s and HH-60s but will train with other DoD units when range scheduling allows. They also utilize small unmanned aerial systems as part of their JTAC training on the range's impact area and Bemiss Field (Callaway 2011; Moody AFB 2011b).

2.1.7 820 BDG

Operating under the 93 AGOW, the 820 BDG was activated in 1997 as an exceptionally trained force protection unit of 12 Air Force Specialty Codes with an airborne capability. To meet this mission, the Group conducts:

- Operations Training—convoy and IED delivery training and sniper fire; ground maneuvering; paradrops and personnel drops; and airfield seizures.
- Weapons/Ammunition/Ordnance Use—training/inert munitions and simunitions.

Currently, only limited amounts of land navigation, ground maneuvering, and small arms (practice rounds only) training occurs at Grand Bay Range (Souza 2011). All initial and pre-deployment qualification requirements and required proficiency training is completed at either Camp Blanding or Fort Stewart (Moody AFB 2000a).

2.1.8 Other Transient Users (Army, Navy, Marine Corps, and Air Force)

Other transient (or visiting) units operate at the Range based on schedule availability. Air-to-ground training includes the Navy and Marine Corps F/A-18s and SH-60s; Marine Corps AV-8s, UH-1s, and AH-1s; Army AH-64, as well as Air Force F-16s, F-15s, CV-22s, U-28s, and AC-130s. Additionally, civilian contractors provide intelligence, surveillance, and reconnaissance services as part of joint training exercises; foreign country allies also conduct air-to-ground operations during the few large force exercises that occur in Moody AFB airspace.

- Targeting Training—bombing, gunnery, tactical deliveries (any direction, altitude, and maneuver within R3008 A-D), conventional deliveries, low/medium/high altitude deliveries, and combat lasers.
- Operations Training—close air support, ground maneuver training, low/medium/high altitude operations, and tactical response to radar and missile threats (any maneuver and direction).
- Weapons/Ammunition/Ordnance—training/inert 20 mm, 30 mm, 2.75 inch, BDU-33, -50, and -56; simunitions; as well as 7.62 mm and 5.56 mm gunnery ammunition.

Currently, only a limited amount of training time on the Range is allocated for other users. Priority is given to aircraft and units based at Moody AFB, and other users are accommodated when scheduling permits.

2.2 Baseline Conditions

2.2.1 Grand Bay Range Impact Area

Grand Bay Range is a multi-purpose, day and night use facility with the principal mission of supporting air-to-ground bombing and gunnery training with inert and training ordnance (Figure 2-1). Along with bombing and gunnery, the Range is equipped to provide basic electronic combat, target selection, and laser training. Because the Range is located adjacent to Moody AFB, resident fixed- and rotary-wing pilots and aircrews can spend more time training and less time transiting to other ranges. For instance, A-10 pilots can practice strafing and other ordnance deployment during air-to-ground training. HH-60s can fire weapons, practice rescue operations, and train for MOUT conditions, as well as prefect landings in brownout situations (i.e., landing when pilot vision is restricted due to flying sand and dust), on slopes, and aboard ships. Range use is undertaken by units stationed at the base but also by transient (i.e., visiting) from the Army, Air Force, Navy, and Marine Corps.

In general, air-to-ground training operations occur during daytime hours. Through interviews with users, data collected from 23 OSS, and previous environmental documentation, it was determined that fixed-wing aircraft (A-10s, F-15s, F-16s, AV-8Bs, and F/A-18s) conduct training 85 percent of the time between 0700 and 2200 hours (7:00 a.m. and 10:00 p.m.) (i.e., environmental daytime hours). The remaining 15 percent would be conducted during environmental nighttime hours or 2200 to 0700 hours (10:00 p.m. to 7:00 a.m.). For rotary-wing aircraft, 40 percent of their operations currently occur during environmental daytime hours and 60 percent during environmental nighttime hours. Table 2-1 presents baseline conditions for air-to-ground ordnance use at Grand Bay Range, identifies users, the type of ordnance, and the average annual number of ordnance authorized.

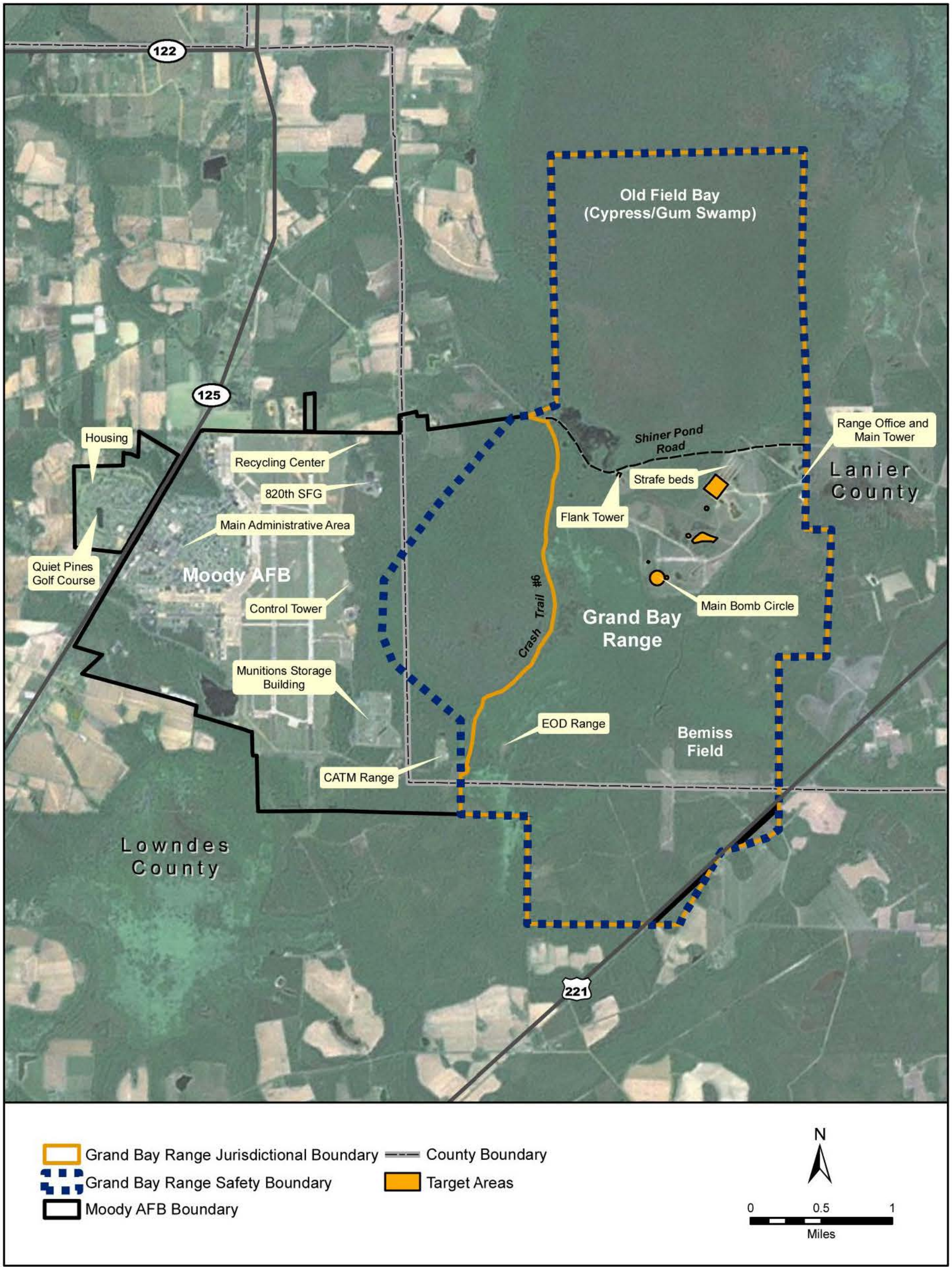


Figure 2-1. Grand Bay Range, Bemiss Field, and EOD Range

Table 2-1. Baseline Annual Air-to-Ground Ordnance Use by Moody AFB and Transient Units

Munitions/Ordnance Type	*Users*	*# of round (annual)*	*Day (0700-2200)*	*Night (2200-0659)*
BDU-33 or Equivalent (≤ 25 pounds)	A-10	5,700	4,845	855
BDU-50/GBU-38i/GBU-12i/LGTR or Equivalent (≤ 500 pounds)	A-10, F-16[1], F-15[1], F-18[1]	276	235	41
BDU-56 or Equivalent (≤ 2,000 pounds)	A-10	32	27	5
7.62 mm	HH-60, UH-1[1]	268,800	107,520	161,280
30 mm	A-10	354,000	300,900	53,100
2.75 inch rockets	UH-1[1], AH-1[1]	920	368	552
.50 cal	HH-60, UH-1[1]	150,000	60,000	90,000
20 mm	F-15[1], F-16[1], F-18[1], AH-1[1]	19,230	16,346	2,885

BDU = bomb dummy unit; cal = caliber; GBU = guided bomb unit; LGTR = laser guided training round; mm = millimeter
Note: [1]Transient expenditures
Sources: Air Force 2008a; 2008b

2.2.2 Bemiss Field

Other ground-based training occurs outside and adjacent to the Impact Area and includes Bemiss Field and adjacent range lands (Figure 2-2); these areas are set aside for 38 RQS, 820 BDG, and 23 EOD ground-based training with inert and simulated munitions, as well as supporting HH-60 landing zones and drop zones for HC-130s of both personnel and equipment. Due to safety considerations, ground-based operations are permitted on Bemiss Field and adjacent training lands only when the Grand Bay Range Impact Area is not active.

The types of training conducted at the Field and adjacent lands include JTAC training where a Wing member operates from a forward position, directing the action of aircraft engaged in close air support and other offensive air operations; convoy and IED delivery training; operating small to medium unmanned aerial systems; joint fire officer training and proficiency; ground maneuvering and ground laser use; integrated participation in aerial training exercises; paradrops and personnel drops; airfield seizures; dry low/medium/high altitude ground attack and close air support maneuvers by fighter/attack/helicopter aircraft from various directions; and air-to-ground combat laser operations. Other ground-based training with inert munitions includes proficiency training (e.g., driving in convoys, conducting vehicle searches, and operating forklifts and diesel generators), force-on-force operations, overnight bivouacking (military encampment made with tents or improvised shelters), land navigation, and small team movement training. The majority (about 60 percent) of current ground-based training operations are conducted between 10:00 p.m. and 7 a.m. (or during environmental night). Table 2-2 presents baseline simunitions (training ammunitions/blanks) used by the 38 RQS and 820 BDG authorized at the impact area, Bemiss Field, and Burma Road (also referred to as Range Road).

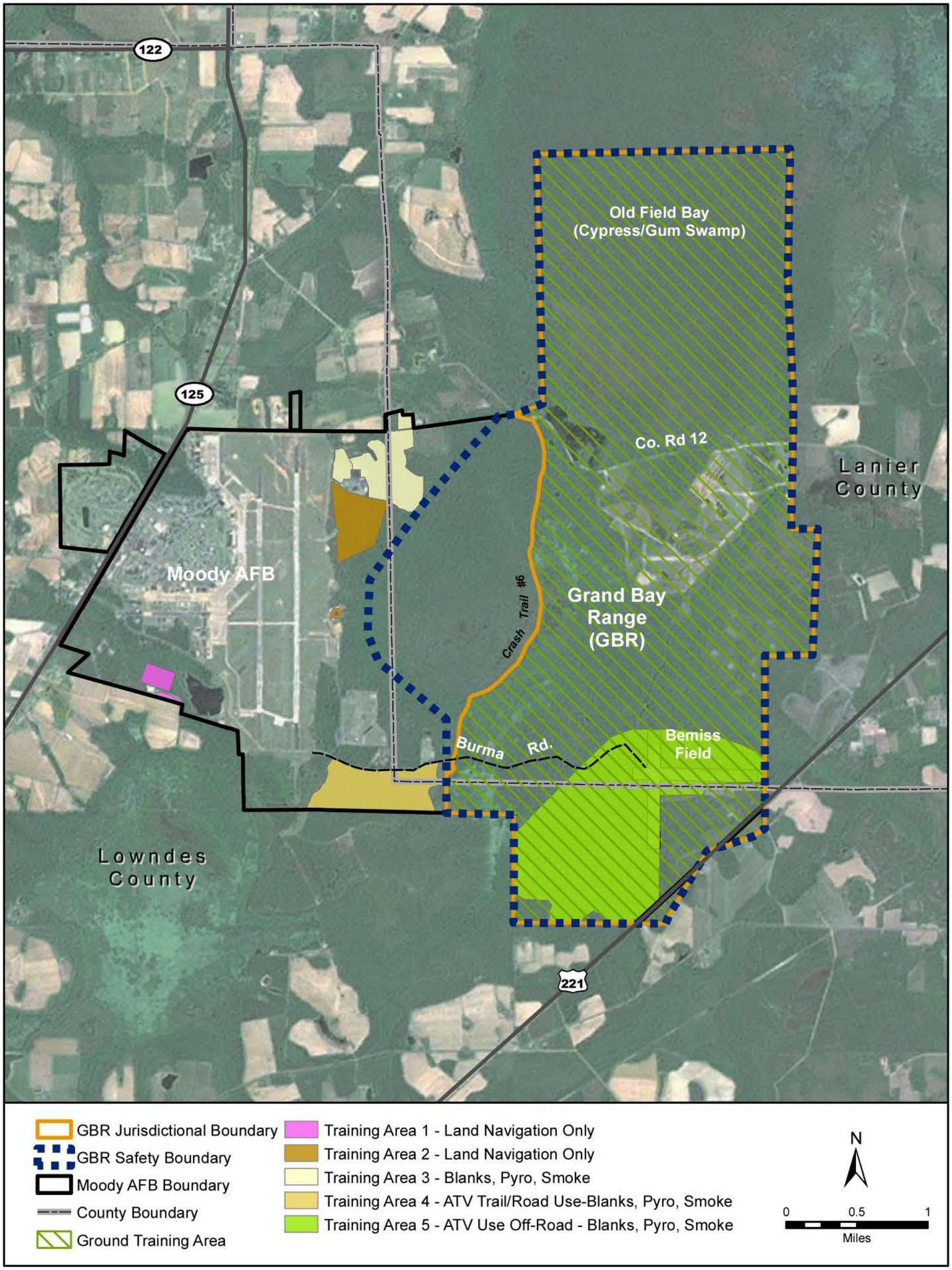


Figure 2-2. Grand Bay Range Ground-Based Training Areas

Table 2-2. Baseline Annual Ground-Based Ordnance by 38 RQS and 820 BDG

Munitions/Ordnance Type[1]	*Baseline Amount*
40 mm	540
Training grenade	0
Pyrotechnics/bursts/smokes	270

mm = millimeter
Note: [1]Reflects simmunitions/blanks at impact areas, Bemiss Field, or Range Road
Source: Moody AFB 2012a

In addition to its current use, a ULZ was approved for Bemiss Field in 2008 and constructed in 2011. The ULZ runs north-south and is 4,100 feet (ft) long and 75 ft wide. Once Bemiss Field has been certified and is in use, the strip would enable Moody AFB personnel rescue units to meet their ULZ qualification and NVG air and land training locally, rather than at remote locations in North Carolina and Florida (U.S. Air Force 2008). In addition, the ULZ would allow these same units to train in mass casualty evacuation; insertion, extraction, and loading of pararescuemen; and extraction of survivors.

2.2.3 EOD Range

The EOD Flight (23 CES/CED) provides unexploded ordnance (UXO) and range decontamination support for Moody AFB. The frequency of range decontamination is based on the type of use, mission requirements, and specific circumstances and is done in accordance with AFI 13-212, *Range Planning and Operations*. The Range also has a semi-annual clearance with clean up typically scheduled during March to April and September to October timeframes. A 5-year clearance was completed in April 2008, and a 10-year clearance was completed in September 2009. EOD personnel use two locations on the range to detonate UXO collected during range clearance activities. One area is located in the southwest corner of the Range and is used for small (60 pound and under) detonations (EOD Site 1). The second area, the Main Bomb Site, is used for larger (100 to 450-pound limit) detonations. Table 2-3 presents the average ground-based explosive training operations for the EOD Flight. All training operations associated with this unit occur during the daytime hours.

Table 2-3. Baseline Annual EOD Flight Ground-Based Ordnance

Ordnance Type	*Baseline Amount*
BDU-33	1,700
BDU-50	50

BDU = bomb dummy unit
Source: Moody AFB 2012a

2.3 Proposed Action and Alternatives

The Air Force proposes to continue conducting range operations as presently done while introducing new air-to-ground and ground-based training activities at Grand Bay Range. The Proposed Action does not introduce radical changes to Range facilities, operations, or training capacities. Rather, the action would result in moderate, but critical training enhancements to support Moody AFB tenants and occasional transient users from other Air Force, Marine Corps, and Navy commands.

The Proposed Action would provide increased ordnance use for air-to-ground training for the 23 FG, 41 RQS, and 71 RQS. It would also extend Grand Bay Range operating hours to support expanded ground-based training as needed. Typically, Grand Bay Range operates 17 hours per day Monday through Thursday, and 8.5 hours on Fridays (which includes a 4-hour maintenance period (Moody AFB 2011b). Under the Proposed Action, the operating hours would be extended to accommodate 820 BDG operations during the night and on weekends after normal flying hours cease. However, extending range operating hours would only occur on an as needed basis. Changes in ground-based operations and increases and changes to ordnance expenditures are needed to:

- Maintain pace with emerging and future air-to-ground training needs through continued upgrading and modernizing of Grand Bay Range's targets and impact areas as well as Bemiss Field;
- Sustain the primary mission of providing air-to-ground training opportunities and the long-term viability of Grand Bay Range, while at the same time protecting human health and the environment;
- Ensure continued ability to support current, emerging, and future EOD ground-based training operations at the Range;
- Offer air-to-ground training assets that meet advanced military technology, including new platforms and weapons systems; and
- Support, to the maximum extent possible, other types of ground-based training for units stationed at the base and other DoD users.

For this EA, two action alternatives and the no action alternative were identified.

2.3.1 Alternatives

In compliance with NEPA and 32 CFR 989, the Air Force must consider reasonable alternatives to the Proposed Action. Only those alternatives determined reasonable relative to their ability to fulfill the need for the action warrant detailed analysis. Criteria used in the development of alternatives are tied to the purpose and need described in Section 1.4. Each alternative was evaluated for its potential to maintain baseline conditions and:

- Increase air-to-ground training operations and ordnance use from current levels to support units based at Moody AFB; and
- Accommodate secondary (tenant and transient) air-to-ground users without constraining existing air-to-ground operations.

In accordance with CEQ regulations (40 CFR 1502.14[d]), a No Action Alternative must also be included and analyzed to serve as a baseline against which environmental impacts of the preferred alternative is measured.

2.3.1.1 No Action Alternative

Under the No Action Alternative, current operations at Grand Bay Range Impact Area, Bemiss Field, and Moody EOD range (as summarized below) would be maintained. Baseline range operations are defined by aircraft utilization, ordnance expenditures, and EOD numbers (refer to Tables 2-1, 2-2, and 2-3 for baseline ordnance use). Under the No Action Alternative, the 820 BDG would continue to travel to either Camp Blanding or Fort Stewart to complete initial and pre-deployment qualification requirements and required proficiency training. This alternative will result in a continued expenditure of personnel time and monetary funds to travel to other locations on a reoccurring basis. For example, completion of qualification requirements results in the travel of 60 gunners for 1 week, six times per year, resulting in travel costs for 1,800 man days.

2.3.1.2 Alternative 1 (Preferred Alternative)

Under Alternative 1, the Air Force would continue to conduct air-to-ground operations as currently done, but there would be increases in ordnance fired on the Grand Bay Range Impact Area. In addition, there would be a minor shift in the daytime versus nighttime split of operations. Specifically, this EA assumed that fixed-wing aircraft stationed at Moody AFB (A-10s) would conduct training 90 percent of the time during environmental daytime hours and the remaining 10 percent would be conducted during environmental nighttime hours. For transient fixed-wing and rotary-wing aircraft, it was assumed 50 percent of the training would be conducted during environmental daytime hours and 50 percent of the training would be conducted during environmental nighttime hours. For rotary-wing aircraft stationed at Moody AFB, no change to the daytime/nighttime split was made.

The preferred alternative would not introduce radical changes to Range facilities, operations, or training capacities. Table 2-4 lists the proposed aerial gunnery and munitions under Alternative 1.

Table 2-4. Alternative 1 Annual Projected Air-to-Ground Ordnance by User, Type, and Number

Moody AFB					
***Ordnance*[1]**	***Users***	***# of rounds (annual)***	***Day (0700-2200)***	***Night (2200-0659)***	***Change from Baseline***
BDU-33 or Equivalent	A-10	12,000	10,200	1,800	+6,300
BDU-50 or Equivalent[2]	A-10	450	405	45	+174
BDU-56 or Equivalent	A-10	76	68	8	+44
7.62 mm	HH-60 (helicopter itself)	600,000	240,000	360,000	+431,200[3]
7.62 mm	HH-60 via PJs from 38 RQS	900	360	540	+900
30 mm[4]	A-10	600,000	540,000	60,000	+246,000
2.75 inch rockets	A-10	1,500	1,350	150	+1,500
.50 cal	HH-60	200,000	170,000	30,000	+54,000
Hand grenades (smoke/practice)	HH-60 via PJs from 38 RQS	140	56	84	+140
5.56 mm	HH-60 via PJs from 38 RQS	8,400	3,360	5,040	+8,400
5.56 mm LKD	HH-60 via PJs from 38 RQS	7,200	2,880	4,320	+7,200
40 mm	HH-60 via PJs from 38 RQS	280	112	168	+280
PROJECTED SUBTOTAL		**1,430,946**	**968,791**	**462,155**	**+756,138**

Table 2-4. Alternative 1 Annual Projected Air-to-Ground Ordnance by User, Type, and Number (continued)

Transients					
Ordnance[1]	***Users***	***# of rounds (annual)***	***Day (0700-2200)***	***Night (2200-0659)***	***Change from Baseline***
BDU-33 or Equivalent	F-15, F-16, F-18	1,800	900	900	+1,800
7.62 mm	UH-1, OH-6, SH-60, MH-60	100,000	50,000	50,000	+431,200[3]
2.75 inch rockets	UH-1, AH-1, OH-6, AH-6, AH-64, MH-60, F-18	250	125	125	-670
.50 cal	UH-1, OH-6, AH-60, MH-60, CV-22	4,000	2,000	2,000	+54,000[3]
20 mm[5]	F-15, F-16, F-18, AH-1, AH-6	37,230	18,615	18,615	+18,000
30 mm[4]	AH-64, MH-60	2,000	1,000	1,000	+2,000
25 mm	AC-130	10,000	5,000	5,000	+10,000
40 mm	AC-130	5,000	2,500	2,500	+5,000
Transient Projected Subtotal		**160,280**	**80,140**	**80,140**	**+521,330**
PROJECTED TOTAL		***1,591,226***	***1,048,931***	***542,295***	***+1,277,468***

BDU = bomb dummy unit; cal = caliber; LKD = linked; mm = millimeter

Notes:

[1]Only inert, training ordnance expended for air-to-ground operations at Grand Bay Range

[2]Includes GBU-38i/GBU-12i/LGTR or equivalent

[3]Change from baseline for 7.62 mm and .50 cal is combined for both resident and transient aircraft

[4]30 mm deployed from helicopters eject brass; on fixed-wing aircraft the brass is contained inside the plane

[5]20 mm deployed from helicopters eject brass; on fixed-wing aircraft the brass is contained inside the plane

Source: Moody AFB 2012a

In addition to the increase in air-to-ground ordnance, ground-based operations would be increased to support the 38 RQS and 820 BDG squadrons training requirements. Specifically, under Alternative 1, the 820 BDG would have the capability for their three squadrons to complete annual initial qualification requirements and some proficiency fire training. However, under this alternative, the 820 BDG would continue to travel to Camp Blanding, FL or Fort Stewart, GA to complete pre-deployment qualification requirements and remaining required proficiency training. Table 2-5 presents the proposed use of live ordnance under Alternative 1; with the exception of 40 mm (M203) grenades and pyrotechnics this would introduce new types of ordnance use at the Range.

No changes to ordnance use described in Section 2.2.3 are anticipated to meet the 23 CES/CED EOD mission requirements.

Table 2-5. Alternative 1 Annual Projected Ground-Based Live Ordnance by User, Type, and Number

Ordnance	*820 BDG*	*38 RQS*	*TOTAL*	*Day (0700-2200)*	*Night (2200-0659)*	*Change from Baseline*
Grand Bay Range Impact Area						
9 mm	68,000	12,000	80,000	60,400	19,600	*+80,000*
7.62 mm (M240/M24)	204,911	5,700	210,611	166,779	43,832	*+210,611*
5.56 mm (M4)	55,000	55,000	110,000	71,500	38,500	*+110,000*
5.56 mm linked (M249)	79,200	19,800	99,000	73,260	25,740	*+99,000*
12 gauge	8,000	0	8,000	6,400	1,600	*+8,000*
SUBTOTAL	**415,111**	**92,500**	**507,611**	**378,339**	**129,272**	***+507,611***
Bemiss Field: Live Fire						
.50 cal (M2)	129,600	0	129,600	103,680	25,920	*+129,600*
7.62 mm (M24 [CPE])	10,785	300	11,085	8,778	2,307	*+11,085*
SUBTOTAL	**140,385**	**300**	**140,685**	**112,458**	**28,227**	***+140,685***
Impact Area/Bemiss Field/Range Road: Simunitions/Blanks						
40 mm grenade (M203)	34,560	2,000	36,560	28,648	7,912	*+36,020*
Training Grenade	1,110	400	1,510	1,088	422	*+1,510*
Pyrotechnics/Bursts/Smokes	7,377	2,000	9,377	6,902	2,475	*+9,107*
SUBTOTAL	**43,047**	**4,400**	**47,447**	**36,638**	**10,809**	***+46,637***
TOTAL	***598,543***	***97,200***	***695,743***	***527,434***	***168,309***	***+694,933***

cal = caliber; mm = millimeter
Source: Moody AFB 2012a

2.3.1.3 Alternative 2

Under Alternative 2, air-to-ground training operations (refer to Table 2-4) would be the same as described under Alternative 1. However, ground-based live ordnance use would increase above Alternative 1 to provide the 820 BDG with the capability for their three squadrons to complete annual initial qualification requirements, pre-deployment qualification requirements, and some proficiency fire at Grand Bay Range and/or Bemiss Field. Under Alternative 2, the 820 BDG would continue to travel to Camp Blanding, FL or Fort Stewart, GA to complete remaining required proficiency training. Table 2-6 presents the projected use of ground-based live ordnance under Alternative 2.

Table 2-6. Alternative 2 Annual Projected Ground-Based Live Ordnance by User, Type, and Number

Ordnance	*820 BDG*	*38 RQS*	*TOTAL*	*Day (0700-2200)*	*Night (2200-0659)*	*Change from Baseline*
Grand Bay Range Impact Area						
9 mm	68,000	12,000	80,000	60,400	19,600	*+80,000*
7.62 mm (M240/M24)	409,822	5,700	415,522	330,708	84,814	*+415,522*
5.56 mm (M4)	55,000	55,000	110,000	71,500	38,500	*+110,000*
5.56 mm linked (M249)	158,400	19,800	178,200	136,620	41,580	*+178,200*
12 gauge	8,000	0	8,000	6,400	1,600	*+8,000*
SUBTOTAL	**699,222**	**92,500**	**791,722**	**605,628**	**186,094**	***+791,722***
Bemiss Field: Live Fire						
.50 cal (M2)	259,200	0	259,200	207,360	51,840	*+259,200*
7.62 mm (M24 [CPE])	21,570	300	21,870	17,406	4,464	*+21,870*
SUBTOTAL	**280,770**	**300**	**281,070**	**224,766**	**56,304**	***+281,070***
Impact Area/Bemiss Field/Range Road: Simunitions/Blanks						
40 mm grenade (M203)	34,560	2,000	36,560	28,648	7,912	*+36,020*
Training Grenade	1,110	400	1,510	1,088	422	*+1,510*
Pyrotechnics/Bursts/Smokes	7,377	2,000	9,377	6,902	2,475	*+9,107*
SUBTOTAL	**43,047**	**4,400**	**47,447**	**36,638**	**10,809**	***+46,637***
TOTAL	***1,023,039***	***97,200***	***1,120,239***	***867,031***	***253,208***	***+1,119,429***

cal = caliber; mm = millimeter
Source: Moody AFB 2012a

2.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER CONSIDERATION

2.4.1 Expansion of Grand Bay Range

The potential for expansion of the Range was initially considered. However, the possibility for range expansion is uncertain at this time and is too speculative to warrant detailed analysis in this EA. The range of issues associated with such an action would almost certainly require an EIS rather than an EA. Therefore, inclusion of an alternative that would address expansion of the Range was considered impractical and was not carried forward for further analysis in this EA.

2.4.2 Supporting All 820 BDG Qualification and Proficiency Requirements

Another alternative considered was to authorize expanded use (greater than proposed under Alternative 2) of live ordnance to fully support 820 BDG qualification and proficiency requirements. While this alternative would meet the 820 BDG ground-based training requirements, it would severely impact the ability of Grand Bay Range to provide its primary mission, which is air-to-ground training. In addition, this alternative would not be viable because the live ordnance would increase the safety danger zones (SDZs) and the Range does not have the geographic area to support these larger safety buffers. Another factor that makes this alternative unfavorable is that ordnance could damage or imbed themselves into trees, making timber sales difficult and potentially affecting tree mortality; thus, greater ordnance expenditures increases the likelihood of tree damage.

2.4.3 Basing Units without a Flying Mission to Other Locations

An alternative that would relocate units, such as the 820 BDG, to another installation was evaluated by Moody AFB. However, at the current time, this alternative is not sufficiently developed for further consideration by the Air Force.

2.4.4 Computer Simulation Training

An alternative that would rely entirely on computer simulated training would not achieve the necessary levels of proficiency in communicating, maneuvering, operating, and firing weapons in a high stress and realistic environment. Computer technologies provide excellent tools for implementing a successful, integrated training program while reducing the risk and expense typically associated with military training. As such, computer simulation is already utilized extensively to enhance combat performance in the Air Force's training program. While this is an essential component of training, computer simulation cannot exactly mimic how it feels when employing ordnance. Consequently, this alternative fails to meet the purpose and need for the Proposed Action and this alternative was not carried forward for analysis.

2.4.5 Alternative Range Training Locations

One alternative that was considered was having Moody AFB units use other training ranges. This alternative would not be viable because the Range is located immediately adjacent to Moody AFB thus limiting transit time to a minimum. This alternative was considered infeasible because it would result in the loss of valuable flight time and fuel needed to travel to and from remote locations.

2.5 IDENTIFICATION OF THE PREFERRED ALTERNATIVE

The preferred alternative that best meets the stated purpose and need is Alternative 1, as described in Section 2.2.1.2. Alternative 1 would best balance Grand Bay Range's primary mission while allowing the 38 RQS and 820 BDG the ability to accomplish additional training requirements at Grand Bay Range.

CHAPTER 3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 ANALYTICAL APPROACH

NEPA requires focused analysis of the areas and resources potentially affected by an action or alternative, and an EA should consider, but is not required to analyze in detail, those areas or resources not potentially affected by the proposal. Therefore, an EA should not be encyclopedic; rather, it should be succinct and to the point. Both description and analysis in an EA should provide sufficient detail and depth to ensure that the agency (i.e., the Air Force) took a hard look at the proposal and the potential impacts it might have on the human and natural environment. NEPA also requires a comparative analysis that allows decision makers and the public to differentiate among the alternatives.

This chapter describes the existing conditions for resources potentially affected by the Proposed Action and alternatives described in Chapter 2. Analysis of the affected environment provides a framework for understanding the direct, indirect, and cumulative effects of the Proposed Action and alternatives.

3.1.1 Resources Analyzed

Table 3-1 presents the potential resources that could be analyzed in this EA. A total of 15 resource categories were evaluated for their potential to be impacted by the Proposed Action: 1) range management and operations; 2) noise; 3) hazardous and toxic materials and waste; 4) public health and safety; 5) recreation; 6) geological resources; 7) biological resources (including vegetation, wildlife, aquatic/wetland habitats, and sensitive species); 8) water resources (including surface and storm water, wetlands, ground water, and floodplains); 9) cultural resources; 10) air quality; 11) utilities; 12) transportation; 13) land use and visual resources; 14) socioeconomics; and 15) environmental justice and protection of children. Consideration was then given to each resource and it was noted whether the resource would be potentially impacted by implementing the Proposed Action or alternatives. If a resource was determined to have negligible or no impacts, the resource was not carried forward for further for analysis; justification for not carrying it forward for further analysis is discussed in Section 3.1.3.

Table 3-1 Resources Analyzed to Determine Need for Further Evaluation

Categories/Resources	*Elements of Proposed Action and Need for Further Evaluation*	
	Changes in Ordnance Use and Type	**Maintain Current Level and Type of Ordnance Use**
Range Management and Operations	Yes	No
Noise	Yes	No
Hazardous Materials and Waste, Toxic Substances, and Contaminated Sites	Yes	No
Public Health and Safety	Yes	Yes
Recreation	Yes	No
Geological Resources	Yes	No
Biological Resources		
Vegetation	Yes	No
Wildlife	Yes	No
Aquatic/Wetland Habitats	Yes	No
Sensitive Species	Yes	No
Water Resources		
Surface and Storm Water	Yes	No
Wetlands	Yes	No
Ground Water	Yes	No
Floodplains	Yes	No
Cultural Resources	Yes	No
Air Quality	No	No
Utilities	No	No
Transportation	No	No
Land Use and Visual Resources	No	No
Socioeconomics	No	No
Environmental Justice and Protection of Children	No	No

3.1.2 Elements of the Proposed Action Eliminated from Further Analysis

Specific elements of the Proposed Action have been analyzed in previous studies and it has been determined there would be minimal or no environmental impact; therefore the following elements were eliminated from further discussion:

- Chaff,
- Flares,
- Pyrotechnics,
- Laser operations, and
- Air-to-ground munitions.

Defensive chaff and flares are used to keep aircraft from being successfully targeted by weapons such as surface-to-air missiles, anti-aircraft artillery, or other aircraft. Chaff is fibers that reflect or mask radar signals, and flares are high temperature heat sources that decoy heat seeking missiles. A bundle of chaff consists of approximately 0.5 to 5.6 million fibers, each thinner than a human hair, that are cut to reflect radar signals and, when dispensed from aircraft, form an electronic "cloud" that breaks the radar signal and temporarily hides the maneuvering aircraft from radar detection. Flares ejected from aircraft provide high-temperature heat sources that mislead heat-sensitive or heat-seeking targeting systems. Flares burn for a short period of time (less than 10 seconds) at a temperature in excess of 2,000 degrees Fahrenheit to simulate a jet exhaust (U.S. Air Force 1997).

Defensive chaff and flares have been analyzed previously for their potential impacts to human health, safety, and physical and biological resources. The materials in chaff are generally nontoxic except in quantities significantly larger than those any human or animal could reasonably be exposed to from chaff use. No significant adverse impacts to safety, air quality, physical (soil, water, land use, visual resources, and cultural resources) resources, or biological resources have been identified (U.S. Air Force 1997).

Toxicity is not a concern with flares, since the primary material in flares, magnesium, is not highly toxic, and it is highly unlikely that humans or animals would ingest flare material. In addition, laboratory analysis indicates that flare pellets and flare ash have little potential for affecting soil or water resources. The primary issue associated with flares is their potential to start fires that can cause a wide variety of impacts on personnel safety, soil, water resources, biological resources, land use, visual resources, and cultural resources (U.S. Air Force 1997). Wildfires are uncommon occurrences at Moody AFB, with an annual average of less than two wildfires on the Installation. Wildfire peak danger periods occur between mid-winter and early summer and then again in mid-fall. Wildfire intensity on the Installation has been lessened through the reduction of fuel loads through prescribed burning, the thinning and management of commercial forest stands, and the creation and annual maintenance of permanent firebreaks throughout the Installation. The initial suppression of wildfires is accomplished by the Moody AFB Fire Department (23 CES/CEF) with assistance from the Environmental Element (23 CES/CEAN). If necessary, the Georgia Forestry Commission is contacted for assistance (Moody AFB 2007a).

Another issue is the potential for dud flares and falling debris to pose safety risks. Although the probability of injury from falling debris was found to be extremely remote, there may be a risk associated with untrained people finding dud flares dropped over land that is not controlled by the DoD (U.S. Air Force 1997). As part of this EA, all flares would be dropped over designated ranges, which is controlled and managed by Moody AFB.

Signals and simulators are pyrotechnic devices used for signaling, illumination, or to simulate battle sounds or conditions. Pyrotechnics give off smoke, light, and/or a loud noise when activated. Examples of pyrotechnics included in the Proposed Action include signal flares, trip flares, countermeasure flares, ground burst simulators, training grenades, and explosive simulators. Flares, smokes, tracers, and other pyrotechnics contain perchlorate (Clausen *et al*. 2007). Because perchlorates are highly soluble and mobile, they can persist in surface water and ground water. The USEPA considers perchlorate an "emerging contaminant," which is characterized as having a perceived, potential, or real threat to human health or the environment or a lack of published health standards (USEPA 2010). At high concentrations, perchlorate can interfere with iodine update into the thyroid gland, which could lead to reduction in the production of thyroid hormones that are critical for normal growth and development. Acute, or short-term, exposures to high doses may cause eye and skin irritation, coughing, nausea, vomiting, and diarrhea (USEPA 2010). A chronic oral reference dose has been established by the EPA which equates to a Drinking Water Equivalent Level (i.e., lifetime exposure concentration that assumes all exposure is from drinking water). In addition, the Office of Solid Waste and Emergency Response established a preliminary remediation goal at National Priority Listing sites (USEPA 2010). Based on a study conducted by Clausen *et al*. (2007), the highest potential for perchlorate environmental impacts are for Air Force sites where multiple launch rocket system rockets have been used; Air Force, Navy, and Marine sites where jet-fuel assisted take off rockets have been used; open burning/open detonation locations; and Marine sites where pyrotechnics and simulated missile fire, in particular Smokey SAMS, have been used. Smokey SAMS contain 238 grams of perchlorate in the propellant and is wholly consumed during the firing of Smokey SAMS. In the rare event of a dud or misfire, the Smokey SAM does not leave the launcher and is subsequently removed from the range. Historic sampling results taken from Moody AFB indicate the presence of perchlorate; however, the results were well below the USEPA and DoD Preliminary Remediation Goal of 15 parts per billion and no further action was needed (DoD 2013). Military range users and activities would be monitored, as deemed necessary, in accordance with applicable federal and state regulations.

Air-to-ground laser operations (combat and training modes) and ground-to-ground laser operations are conducted on Grand Bay Range. Guidance on the use of laser designators, illuminators and pointers on Air Force ranges can be found in American National Standards Institute Standard Z136.6, *American National Standard for Safe Use of Lasers Outdoors*; Military Handbook 828B, *Range Laser Safety*; AFI 13-212, *Range Planning and Operations*; and DoD Instruction 6055.15, *DoD Laser Protection Program*. AFI 13-212, *Range Planning and Operations*, requires laser range surveys be completed for laser range certification. A survey has been completed and Grand Bay Range is certified in accordance with AFI 13-212, *Range Planning and Operations* and Air Force Occupational Safety and Health (AFOSH) Standard 48-139, *Laser Radiation Protection Program* for the safe use of authorized laser systems. No change in laser operations from baseline conditions would occur under the Proposed Action. Moreover, laser operations will continue to be conducted at Moody AFB in accordance with these guidance and regulatory documents.

3.1.3 Resources Eliminated from Further Analysis

NEPA and CEQ regulations, as well as Air Force procedures for implementing NEPA, specify that an EA should focus only on those resource areas potentially subject to impacts. In addition, the level of analysis applied to any given resource area should be commensurate with the level of impact anticipated for that resource. Applying these guidelines, the following resource areas were not analyzed in this EA: air quality, utilities, transportation, land use and visual resources, socioeconomics, and environmental justice and protection of children. It is anticipated that no impacts to these resources would occur; a discussion as to why these resources were eliminated from detailed analysis is provided below.

Air Quality. The Clean Air Act (CAA) requires the USEPA to establish National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. There are primary and secondary standards under the NAAQS. Primary standards set limits to protect public health, including “sensitive” populations. Secondary standards set limits to protect public welfare, including protection from decreased visibility, damage to animals, crops, vegetation, and buildings. Areas that are in violation of the NAAQS are designated as *non-attainment areas.* Moody AFB, Grand Bay Range, and Bemiss Field are located in the Southwest Georgia Air Quality Control Region (AQCR). As defined in 40 CFR 81.238, the Southwest Georgia AQCR encompasses Lowndes County and Lanier County, Georgia. The Southwest Georgia AQCR is in attainment for all six criteria pollutants.

The Proposed Action and alternatives would have minimal impacts to local air quality. Specifically, signals and simulators are pyrotechnic devices used for signaling, illumination, or to simulate battle sounds or conditions. Pyrotechnics give off smoke, light, and/or a loud noise when activated. Examples of pyrotechnics included in the Proposed Action include signal flares, trip flares, countermeasure flares, ground burst simulators, training grenades, and explosive simulators. Signal flares are used for communication among troops in the field and for illumination; trip flare warns of infiltrating troops by lighting up the field; aircraft countermeasure flares are used to decoy infrared-seeking missile threats away from the aircraft; ground burst simulators creates battle noises and flashes mimicking that of shells in flight and ground explosions similar to a live grenade; hand grenade simulators mimic the sounds and flashes of actual grenades used during combat; and explosive simulators mimic battle sounds and flashes.

The primary emissions from the use of signals and simulators are carbon dioxide (CO_2) and/or particulate matter. The primary emissions from the use of munitions are CO_2 and carbon monoxide (CO). Other criteria pollutants, hazardous air pollutants as defined by the *Clean Air Act* (CAA), and toxic chemicals (i.e., those chemicals regulated under Section 313 of the *Emergency Planning and Community Right-to-know Act* [EPCRA]) are emitted at very low levels. As ordnance is typically used in the field, there are no controls associated with its use (USEPA 2008; 2009). No new point or nonpoint sources would be created, and there would continue to be only minor short- and long-term fugitive dust impacts due to range operations but would not impact air quality. Because the Proposed Action would constitute only minor changes to existing emissions levels and local air quality would not be degraded, air quality is eliminated from further consideration in this EA.

Utilities. The Proposed Action and alternatives would not affect utilities (power, communication, sewage, and solid waste) availability or service. The provision of utilities services, including resource consumption and disposal, would not be affected by Proposed Action and alternatives. No further analysis of utility resources is carried forward in this EA.

Transportation. Transportation resources refer to the infrastructure and equipment required for the movement of people, manufactured goods, and raw materials in geographic space. Under the Proposed

Action and alternatives, none of these transportation facets would be altered from existing conditions, therefore, this resource was not carried forward for further analysis.

Land Use and Visual Resources. The Proposed Action would be in accordance with established land use development guidelines addressing safety, functionality, and environmental protection. Furthermore, the Proposed Action would be fully consistent with ongoing activities at Grand Bay Range and constitute a continuation of similar training activities. Moody AFB would continue working with community leaders in support of the existing Moody Activities Zoning (MAZ) District as discussed in the Lowndes County Unified Land Development Code. The purpose of the MAZ is to ensure safety to people and property within the zone; prohibit the establishment of incompatible structures; protect the airspace from the establishment of structures or placement of objects that interfere with the safe operation of aircraft; limit land uses to those that are compatible with Moody AFB; protect people and property from potential adverse effects of aircraft noise and aircraft crashes; and ensure the continued presence of Moody AFB (U.S. Air Force 2008c).

The Southern Georgia Regional Commission initiated a Joint Land Use Study in 2008. Initially the study area included Berrien, Lanier, and Lowndes Counties and was expanded to include Clinch and Echols Counties. The Joint Land Use Study indicated that previously adopted land use regulations have been effective in minimizing incompatible development within Moody AFB's mission area. As a result, the Southern Georgia Regional Commission and Moody AFB began working together to implement a series of recommendations arising from the completion of the Joint Land Use Study. In July 2012, the Southern Georgia Regional Commission released a Draft Moody AFB Joint Land Use Study. If the recommendations are implemented, incompatible development within Moody AFB's mission area would be further prevented (Georgia Regional Commission 2012).

In summary, no changes to land management or use would occur with implementation of the Proposed Action; therefore, this resource has not been considered for further detailed analysis in this EA.

For visual resources, implementing the Proposed Action and alternatives would have no impacts on the visual character of Grand Bay Range, Bemiss Field, Moody EOD range—it will maintain its military mission purpose. In addition, the overall visual setting at the Range is not readily visible to the public and therefore, unlikely to disrupt any existing view sheds. This resource has not been considered for further detailed analysis in this EA.

Socioeconomics. Socioeconomics focuses on the general features of the local economy that could be affected by the Proposed Action. It is expected that implementation of the Proposed Action would not result in the creation of any new jobs, no new housing would be required, and there would be no additional school-aged children. Therefore, it is anticipated no communities would be exposed to adverse socioeconomic impacts, and this resource has been eliminated from further analysis.

Environmental Justice and Protection of Children. Implementation of the proposed action would comply fully with Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority and Low-income Populations*, and EO 13045, *Protection of Children from Environmental*

Health Risks and Safety Risks. The existence of disproportionately high and adverse impacts depends on the nature and magnitude of the effects identified for each of the individual resources. The Proposed Action would be contained entirely within the boundaries of Moody AFB, and no low-income or minority populations would be impacted by implementation of the Proposed Action. Furthermore, neither schools nor children are located near Grand Bay Range. Therefore, the Proposed Action would not disproportionately impact low-income or minority populations, or result in disproportionate risks to children from environmental health or safety risks. As such, this resource is not carried forward for more detailed analysis.

3.1.4 Affected Environment

The affected environment (or ROI) is the same for each alternative due to the limited geographic scope and locally isolated environmental interactions that are anticipated. For all alternatives, and for all resource categories, the potentially affected environment is Moody AFB and associated Grand Bay Range, Bemiss Field and the EOD range.

3.2 RANGE MANAGEMENT AND OPERATIONS

A range is an area established for operations, training, research and development, and test and evaluation of military systems, personnel, tactics, munitions, and explosives. AFI 13-212, *Range Planning and Operations*, provides guidance for the planning, operations, management, safety, equipment, facilities, and security of Air Force ranges. AFI 12-212 requires preparation of a Comprehensive Range Plan, which addresses various items including, but not limited to, scheduling issues, modernization planning, safety, noise management, public affairs, and encroachment. AFPD 13-2, *Air Traffic, Airfield, Airspace, and Range Management*, establishes AF policy and provides guidance for Airspace/Range Management and Airfield Operations to include Air Traffic Control and Airfield Management. Moody AFB has prepared the Grand Bay Comprehensive Range Plan (Moody AFB 2011b) to enhance the compatibility of land and airspace use on and around the Range, provide guidance to meet short and long term needs, identify any existing or potential conflicts, and propose alternative solutions and recommendations.

3.2.1 Affected Environment

The majority of Installation military training activities are concentrated in five main areas: Moody AFB airfield (main base), security forces and rescue squadron training areas (main base), Grand Bay Weapons Range impact area (on Grand Bay Range), Bemiss Field (on Grand Bay Range), and the EOD range (on Grand Bay Range) (Moody AFB 2007a). For the purposes of this EA, the affected environment includes the Grand Bay Range impact area, Bemiss Field, and the EOD range.

3.2.1.1 Grand Bay Range

As shown in Figure 2-1, Grand Bay Range includes support facilities, impact areas and targets; Bemiss Field; and EOD range (referred inclusively as the Range). The Range encompasses 5,874 acres northeast of Valdosta and directly east of Moody AFB. Range offices, structures, and impact areas occupy about 500 acres along the northeastern range boundary. Typically, Grand Bay Range operates 17 hours per day

Monday through Thursday, and 8.5 hours on Fridays (which includes a 4-hour maintenance period). Depending on the season, the 17-hour operational window occurs between 0800 and 0200 (i.e., 8:00 a.m. and 2:00 a.m.). Operations conducted outside of these hours are accommodated, but only after prior coordination and approval by Range control (Moody AFB 2011b). The 23 FG provides management and maintenance for the Range.

The 450-acre impact area (Figure 3-1) is primarily an air-to-surface range; the following features support aircraft using the area for simulated bombing and strafing activities:

- **Main Bomb Site:** this conventional bull's eye target is the most heavily used. It is designed as a simple, easily identified generic drop target and is available as a lighted target for night missions. Bombing maneuvers include dive bomb, low-angle bomb, low-angle low drag, and dive-toss.
- **Strafe Pit:** accommodates high- and low-angle strafing. There are five lanes; Lanes 1 through 4 are only for low-angle strafe and Lane 5 is only for high-angle strafe. Strafing events involve an aircraft approaching a target at a 5- to 15-degree angle and firing weapons.
- **Military Operations in Urban Terrain:** consists of large steel shipping containers stacked to simulate urban buildings. There are three areas to conduct this type of training: North Village, South Village, and the Airfield Village.
- **SAM Sites:** designed as a representation of a fixed site or similar strategic threat system with one control radar in the center surrounded by five missile transporter erector launchers.
- **Smokey SAM:** a "missile/rocket" (made of paper and styrofoam products) that is launched into the air to realistically simulate a SAM deployment. It is named "smokey" due to its very visible cloud of smoke that trails the missile after it is launched.
- **Other Targets**: Static representations of airplanes, trucks, tanks, and military convoys found throughout the impact area and at Bemiss Field. Several of the targets have an infrared (IR) system for training aircrews in locating targets by an IR signature.
- **Moving Target:** is a remotely operated, guided target that is armored to resist damage when hit by ordnance. It moves along a steel track system and is backed by a berm.
- **Threat emitters:** mobile units simulating multiple types of radar threats, infrared/ultraviolet (IR/UV) targets, and anti-aircraft artillery on the entirety of range property.

Within the impact area, the Weapons Impact Scoring System (WISS) is used to assess aircrew targeting ability. This system is composed of multiple cameras mounted at two locations: one bank of cameras is located in the main tower, while the other is located in the flank tower. The WISS optically measures miss distance from where the ordnance landed relative to the target. When a weapon impacts the target, a spotting charge is emitted and the WISS cameras allow the operator to mark the delivery position from each of the towers. The system then triangulates the impact to give the score. This is the primary scoring system at Main Bomb Site. At the strafe pit, scoring is done using the Improved Remote Strafe Scoring System.

Figure 3-1. Grand Bay Range Target Areas

Grand Bay Range is certified for laser air-to-ground (combat and training modes) and ground-to-ground operations (Moody AFB 2011b). There are specific laser systems authorized, limitations on flight profiles established, Laser Target Areas and ground-based Firing Positions identified, as well as established Laser Surface Danger Zones. The Range also supports NVG training upon request; compatible lighting is installed on several targets to support this type of training. Live ordnance use is currently prohibited on Grand Bay Range; as such, aircraft deploy solid, non-explosive ammunitions for training. As listed in Table 2-1, training ordnance authorized and primary aircraft deploying these munitions include the following:

- BDU-33 (A-10s, F-15, and F-16s [or equivalent], and F-18s or similar fighter/attack aircraft),
- BDU-50/Guided Bomb Unit-38i (GBU-38i)/GBU-12i/laser guided training rounds (A-10s, F-15s, F-16s, and F-18s),
- BDU-56 (A-10s),
- 2.75 inch practice (inert) rocket (UH-1s, AH-1s, A-10, F-18, F-16, AH-1, and AH-64),
- 7.62 mm practice ammunition (HH-60s, UH-1s).
- Training Practice (TP) ammunition for 20 mm (AH-1s, F-15s, F-16s, and F-18s) and 30 mm (AH-64 and A-10), and
- .50 cal rounds (HH-60s, UH-1s).

The predominant training bomb used on the Range is the BDU-33. This is a small training bomb, composed of cast iron and steel, and equipped with a spotting charge that serves as an aid for visual scoring of delivery accuracy. While 250 of the 2.75-inch practice rockets (equipped with M156 white phosphorous warheads) have been authorized (U.S. Air Force 2006), the M156 has not been employed to date. Depleted uranium rounds are not authorized.

The primary structures at Grand Bay Range include the following:

- Building 1 – Flank tower containing the second bank of video cameras for the WISS Scoring System.
- Building 2 – The main control tower housing scoring personnel and equipment.
- Building 7 – Vehicle maintenance building and lift station.
- Building 10 – Personnel building housing various administrative functions.
- Buildings 13 and 14 – Hazardous material accumulation site, oil and grease storage.
- Non-numbered Buildings – These include the new target preparation facility, equipment storage, and Range user briefing building (Moody AFB 2011b).

3.2.1.2 Bemiss Field

Bemiss Field is a 95-acre reclaimed landing strip located on the southern portion of Grand Bay Range. In the 1940s, Bemiss Field was used as an auxiliary airstrip for Moody AFB. The original asphalt cover was removed, the site re-vegetated with grass, and the surrounding area cleared of trees and obstructions. Bemiss Field is currently used for various military training activities, including combat survival and threat scenario training, and has a HH-60 landing zone and C-130 DZ.

In addition to its current use, a ULZ was approved for Bemiss Field in 2008 and subsequently constructed in 2011. The ULZ runs north-south and is 4,100 ft long and 75 ft wide. Once Bemiss Field has been certified and is in use, the strip would enable Moody AFB personnel rescue units to meet their ULZ qualification and NVG air and land training locally, rather than at remote locations in North Carolina and Florida (U.S. Air Force 2008a). In addition, the ULZ would allow these same units to train in mass casualty evacuation; insertion, extraction, and loading of pararescuemen; and extraction of survivors. For safety considerations, training at Bemiss Field is closed to all activities when Grand Bay Range is in use.

3.2.1.3 EOD Range

The EOD range is located west of Dudley's Hammock on a fill-area in Rat Bay. The EOD range is used to conduct training of EOD personnel in the safe detonation of ordnance and for the disposal of unexploded ordnance from military operations, including those from the Grand Bay Range impact area.

The 23 CES/CED (EOD Flight) provides UXO and range decontamination support for Moody AFB. All activities on the EOD range are concentrated on the actual range, consisting of approximately 1 acre. EOD personnel use two locations on the range to detonate UXO collected during range clearance activities. One area is located in the southwest corner of the Range and is used for small (60 pound and under) detonations (EOD Site 1). The second area, the Main Bomb Site, is used for larger (100 to 450-pound limit) detonations. Detonations occur in specially designed bunkers (Moody AFB 2007a).

3.2.1.4 Airspace

Restricted airspace, R-3008, overlies Grand Bay Range (Figure 3-2) and is divided into four areas with the following airspace floor and ceiling limits:

- R-3008A – Surface up to but not including 10,000 ft mean sea level (MSL);
- R-3008B – 100 ft above ground level (AGL) up to but not including 10,000 ft MSL;
- R-3008C – 500 ft AGL up to but not including 10,000 ft MSL; and
- R-3008D – 10,000 ft MSL up to but not including 23,000 ft MSL.

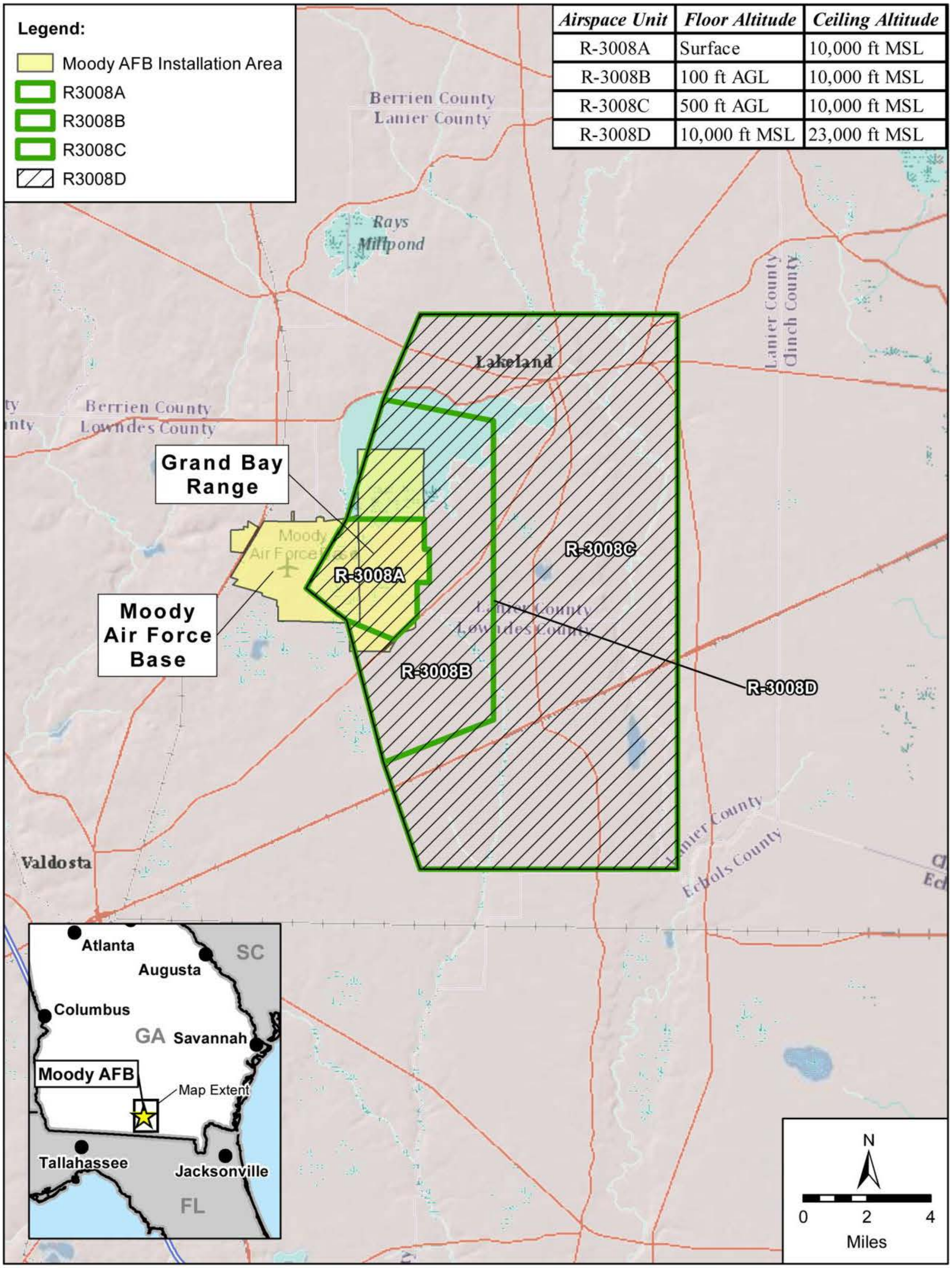
Moody AFB Class D Airspace (which extends from the surface to 2,500 ft AGL), abuts Range airspace to the west to support airfield operations, and Moody military operations areas (MOAs) 2 North and South adjoin R-3008 airspace to the east. Class D airspace requires pilots to establish and maintain two-way radio communication with the air traffic control tower before entering this restricted airspace. Primary attack headings for A-10 munitions releases and airdrop operations are from northern, southern, and eastern directions. HH-60s fly various patterns to accommodate side fire operations (Moody AFB 2011c). Valdosta Regional Airport Approach Control (RAPCON) has overall jurisdiction over R-3008; however, the 23 OSS schedules range time and controls operations within this restricted airspace as well as for all of the Moody AFB MOAs. When these airspace units are not in use, control is turned over to Valdosta RAPCON.

3.2.2 Environmental Consequences

Impacts would be considered significant if range operations increased to such an extent that Grand Bay Range, Bemiss Field, or the EOD range could not operate safely, effectively, and efficiently.

3.2.2.1 Action Alternatives

Under both Alternatives 1 and 2, the range operations would continue to be managed in accordance with the Grand Bay Comprehensive Range Plan. While scheduling would be more difficult under Alternative 2 due to the increase amount of ground-based operations, range operations would continue to be scheduled and training activities deconflicted in a manner that would ensure its safe, effective, and efficient operations in accordance with all applicable Air Force requirements. In addition, impacts associated with airspace operations are being analyzed and documented in a separate NEPA document. Any adverse impacts to range operations from implementation of Alternatives 1 or 2 would be expected to be less than significant.



Airspace Unit	Floor Altitude	Ceiling Altitude
R-3008A	Surface	10,000 ft MSL
R-3008B	100 ft AGL	10,000 ft MSL
R-3008C	500 ft AGL	10,000 ft MSL
R-3008D	10,000 ft MSL	23,000 ft MSL

Figure 3-2. Grand Bay Range Regional Airspace

3.2.2.2 No Action Alternative

Under the No Action Alternative, Grand Bay Range, Bemiss Field, and EOD range operations would continue at current levels at existing target and training areas. Range operations would continue to be scheduled and training activities deconflicted in a manner that would ensure its safe, effective, and efficient operations in accordance with the Grand Bay Comprehensive Range Plan. As such, baseline conditions would persist under the No Action Alternative, resulting in negligible adverse impacts.

3.3 Noise

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air or water, and are sensed by the human ear. Sound is all around us. Noise is defined as unwanted or annoying sound that interferes with or disrupts normal human activities. Although exposure to very high noise levels can cause hearing loss, the principal human response to noise is annoyance. The response of different individuals to similar noise events is diverse and is influenced by the type of noise, perceived importance of the noise, its appropriateness in the setting, time of day, type of activity during which the noise occurs, and sensitivity of the individual.

Noise and sound are expressed in decibels (dB), which is a logarithmic unit. A sound level of 0 dB is approximately the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB; sound levels above 120 dB begin to be felt inside the human ear as discomfort. Sound levels between 130 to 140 dB are felt as pain (Berglund and Lindvall 1995). The minimum change in the sound level of individual events that an average human ear can detect is about 3 dB. On average, a person perceives a doubling (or halving) of the sound's loudness when there is a 10 dB change in sound level. Appendix C provides a more detailed presentation of noise definitions, methodology, and modeling.

All sounds have a spectral content, which means their magnitude or level changes with frequency, where frequency is measured in cycles per second or hertz (Hz). To mimic the human ear's non-linear sensitivity and perception of different frequencies of sound, the spectral content is weighted. For example, environmental noise measurements are usually on an "A-weighted" scale that filters out very low and very high frequencies in order to replicate human sensitivity. It is common to add the "A" to the measurement unit (i.e., dBA) in order to identify that the measurement has been made with this filtering process. For infrequent and/or impulsive noises, such as EOD and small arms munitions, the single largest pressure value, known as the peak level, is used. This value does not have any filtering added and is simply the loudest instantaneous noise level.

When hearing noise, the following variables can affect a person's reaction:

- Intensity,
- Duration,
- Repetition,
- Abruptness of the onset or stoppage of the noise,
- Background noise levels,

- Interference with activities,
- Previous community experience with the noise,
- Time of day exposure occurs,
- Fear of personal danger from the noise sources, and
- Extent that people believe the noise can be controlled (USACHPPM 2006).

All of these factors play into how annoyed the community may feel at any one time when noise is generated at the Range. To assist the community in land-use planning and zoning, the Air Force undertakes the Air Installation Compatible Use Zone (AICUZ) Program. This Program was established in the early 1970s by the DoD to balance the need for aircraft operations with community concern over aircraft noise and accident potential. The goals of the AICUZ Program are to protect the health, safety, and welfare of those living and working near military airfields and to preserve the military flying mission. The AICUZ study analyzes aircraft noise, accident potential, land use compatibility, and operational procedures, and it provides recommendations for compatible development near air installations. The purpose of the AICUZ Program is to promote compatible land development in areas subject to aircraft noise and accident potential due to aircraft operations.

Noise Modeling. To derive the noise level contour bands, the following software models are used for evaluating small arms and large-caliber weapons:

- Small Arms Range Noise Assessment Model (SARNAM) was used to calculate noise levels from .50 cal and smaller munitions. The SARNAM model considers the type of weapon and ammunition, number of rounds fired, range attributes such as size and barriers (e.g., berms, trees, and topography), time of day weapons are used, and the trajectory/directivity of both muzzle blast and projectile. Since the use of average noise levels over a protracted time period generally do not assess the probability of community noise complaints from weapons firing, the analysis of munitions uses a single event metric.
- BNOISE2 calculates and portrays noise level contours for peak level for single event blast noise associated with and EOD activities. Blast noise is impulsive in nature and of short duration. It considers explosive charge type, detonation points, and time of day.

In this EA, the metric used to measure single event noise levels for small arms and EOD activities is Peak15 (PK15[met]). PK15(met) accounts for the statistical variation in received single event peak noise level that is due to weather. Specifically, this metric is the calculated peak noise level, without frequency weighting, expected to be exceeded by 15 percent of all events that might occur. In other words, 85 percent of all events would be expected to occur at the PK15(met) metric. If there are multiple weapon types fired from one location, or multiple firing locations, the loudest of the single event levels is used in the PK15(met) analysis.

The Air Force does not provide guidance for impulse noise. Therefore, in this EA, Army Regulation (AR) 200-1, *Environmental Protection and Enhancement,* was used to assess the impact on the noise environment associated with the proposed ground-based operations involving live fire at the Grand Bay

Range Impact Area and Bemiss Field. (Since operations involving simunitions/blanks have reduced pressure and noise levels, the noise associated with these operations are not analyzed.) Noise exposure levels are depicted visually for analytical purposes as noise contours that connect points of equal value. These noise contours are overlaid on a map; the area encompassed by a specific range of noise indicated by the noise contours is a noise zone. In AR 200-1, there are three noise zones associated with small arms operations and these are based on the PK15(met) metric. These three noise zones and their associated noise limits are listed in Table 3-2.

Table 3-2. Noise Limits for Peak Noise Zones for Small Arms (PK15[met])

Noise Zone	***Noise Limit (dB)***
Zone I	< 87
Zone II	87 – 104
Zone III	> 104

Source: U.S. Army 2007

Under this approach, noise levels for small arms are categorized into three zones in order to determine compatibilities with noise sensitive land uses (e.g., housing, schools, and medical facilities). In Noise Zone I, sensitive land uses are normally considered compatible; in Noise Zone II, sensitive land uses are normally not compatible; and in Noise Zone III, sensitive land uses are not recommended.

Due to the infrequency of blast noise analyzed in this EA, the most appropriate analysis is an analysis of risk of noise complaints from peak noise levels. AR 200-1 does not include land use compatibility guidelines for peak noise levels associated blast noise, but uses PK15(met) as a good predictor of risk of complaints, as presented in Table 3-3. For this EA, PK15(met) blast noise contours do not include the higher risk of noise complaints associated with the greater than 130 dB PK15(met) levels.

Table 3-3 Risk of Noise Complaints from Blast Noise (PK15[met])

Risk of Noise Complaints	***Noise Limits (dB)***
Low	< 115
Medium	115 – 130
High	130 – 140
Risk of physiological damage to unprotected human ears and structural	> 140

Source: U.S. Army 2007

3.3.1 Affected Environment

The affected environment includes those areas affected by ground-based operations within the Range. Noise generated by aircraft overflights would not change under this proposal; therefore, these are not modeled for the purposes of this EA. However, Moody AFB is currently preparing a separate NEPA document that, when completed, will analyze aircraft generated noise levels and depict the aviation-related noise contours at the Range. However, air-to-ground delivery of munitions from aircraft to the Range has occurred for many years. Although these types of air-to-ground operations do generate noise, the Air Force does not analyze noise exposure from air-to-ground operations with noise modeling. This

EA analyzes the noise associated with ground-based operations, including small-arms from the 38 RQS and 820 BDG, and blast noise from EOD operations.

Currently, there is very little ground-based small-arms training occurring on Grand Bay Range, and any munitions presently expended on the Range by the 38 RQS or 820 BDG are simunitions/blanks, which produce small noise footprints; therefore, noise associated with the firing of simunitions/blanks under baseline conditions are considered negligible.

Baseline EOD operations result in peak blast noise levels that correspond to low and moderate risk of noise complaints during the time when such operations occur. Figures 3-3 and 3-4 depict the baseline PK15(met) sound levels for bomb disposal and detonation operations at the Grand Bay Range Main Bomb Circle and EOD range, respectively. Under baseline conditions, noise levels greater than 130 dB (corresponding to moderate risk of noise complaint) do extend off base. Moody AFB notifies the public when the twice-yearly large detonation involving a 450-lb bomb is scheduled. The Installation did not received noise complaints related to range operations in 2011 through October 2012 (Benroth 2012).

3.3.2 Environmental Consequences

Noise impacts would be considered significant if noise levels would increase to such an extent that they could adversely impact the human and/or natural environment or be incompatible with adjacent land uses. The human ear perceives changes in loudness on the logarithmic scale. For example, a 3-dB change would be barely perceptible, a 5-dB change would be quite noticeable, and a 10-dB change would be twice or half as loud.

3.3.2.1 Action Alternatives

As shown in Tables 2-5 and 2-6, under Alternatives 1 and 2, the same type of small arms weapons would fire live munitions at either the Grand Bay Range Impact Area or Bemiss Field. Because the PK15(met) noise metric is used to predict the potential noise impacts associated with small arms operations, the actual number of rounds fired does not factor into the overall noise footprint. Therefore, Alternatives 1 and 2 are expected to produce the same noise footprint, and for that reason, are discussed together. For the purposes of noise modeling, it was assumed that munitions would occur at two locations (at the Grand Bay Range Impact Area and at Bemiss Field) with no movement; this assumption assumes the shooter would fire all rounds within the shooter area located closest to the Installation boundary. Therefore, the noise modeling resulted in the most conservative approach (i.e., worst case scenario). In reality, however, the shooter would move within the shooter area. Figure 3-5 presents PK15(met) noise levels for all ground-based operations involving live fire that would occur at the Grand Bay Range Impact Area and Bemiss Field under Alternatives 1 and 2.

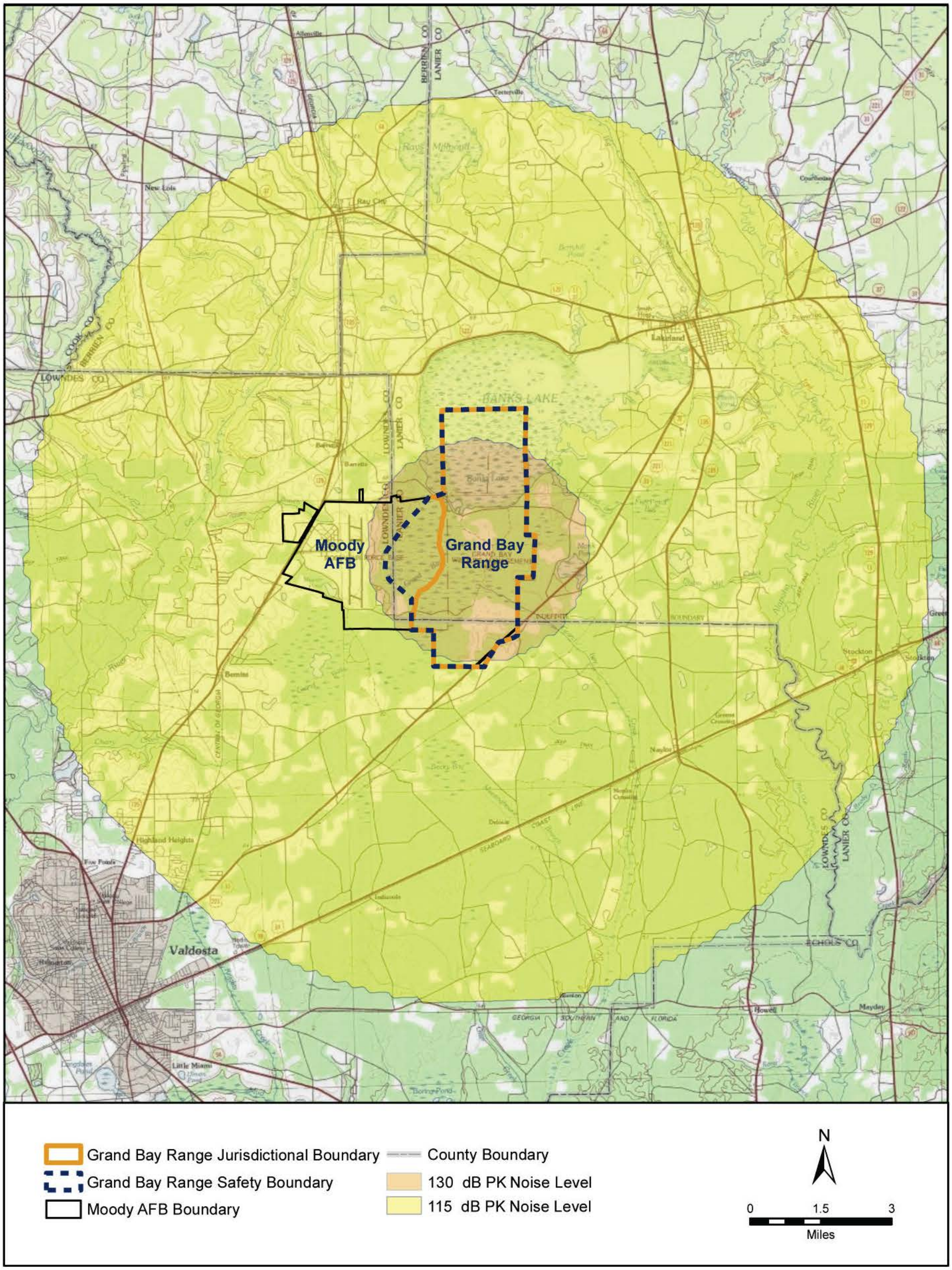


Figure 3-3. Noise Contours for Existing EOD Operations at the Range Main Bomb Circle

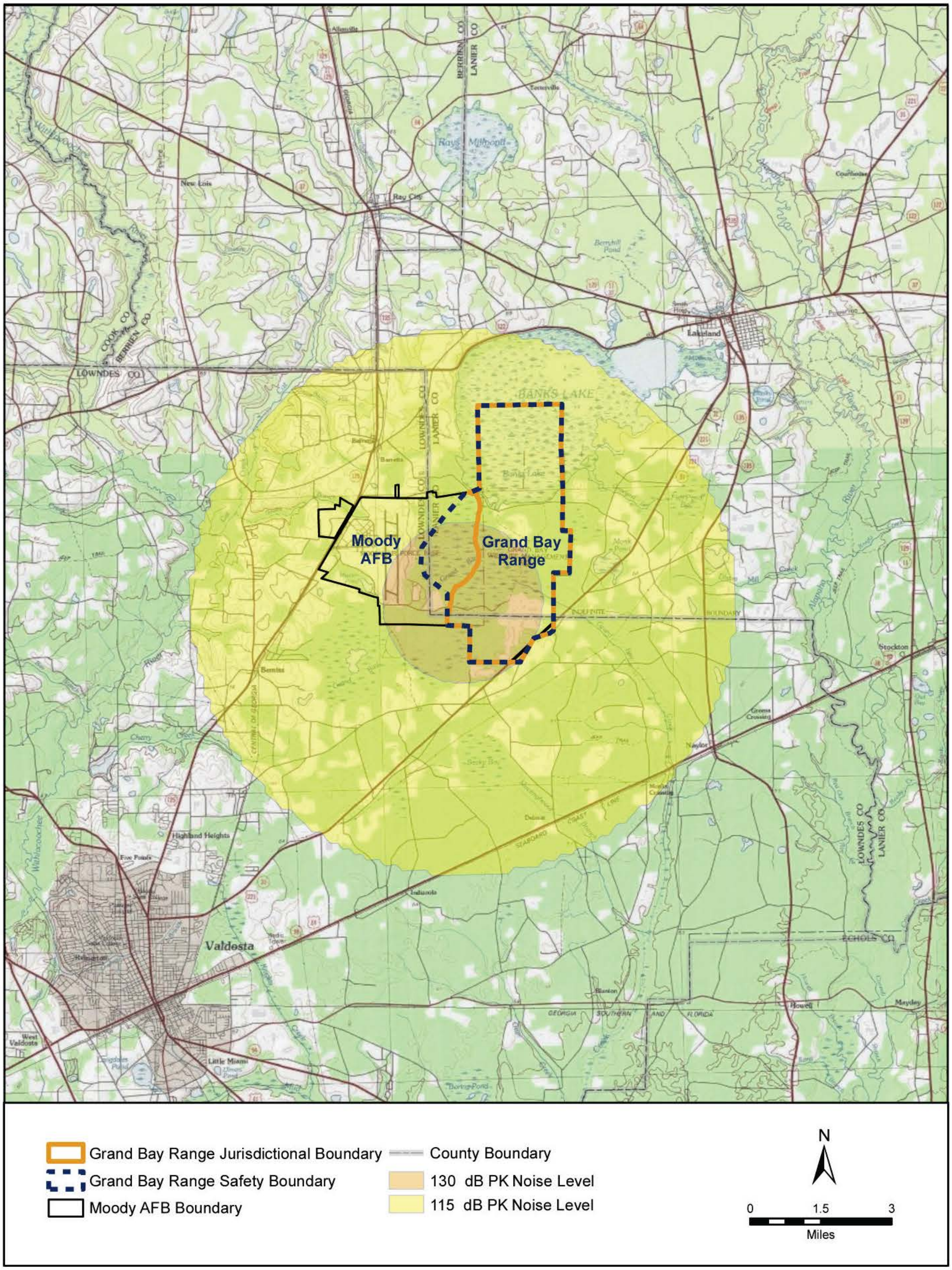


Figure 3-4. Noise Contours for Existing EOD Operations at the EOD Range

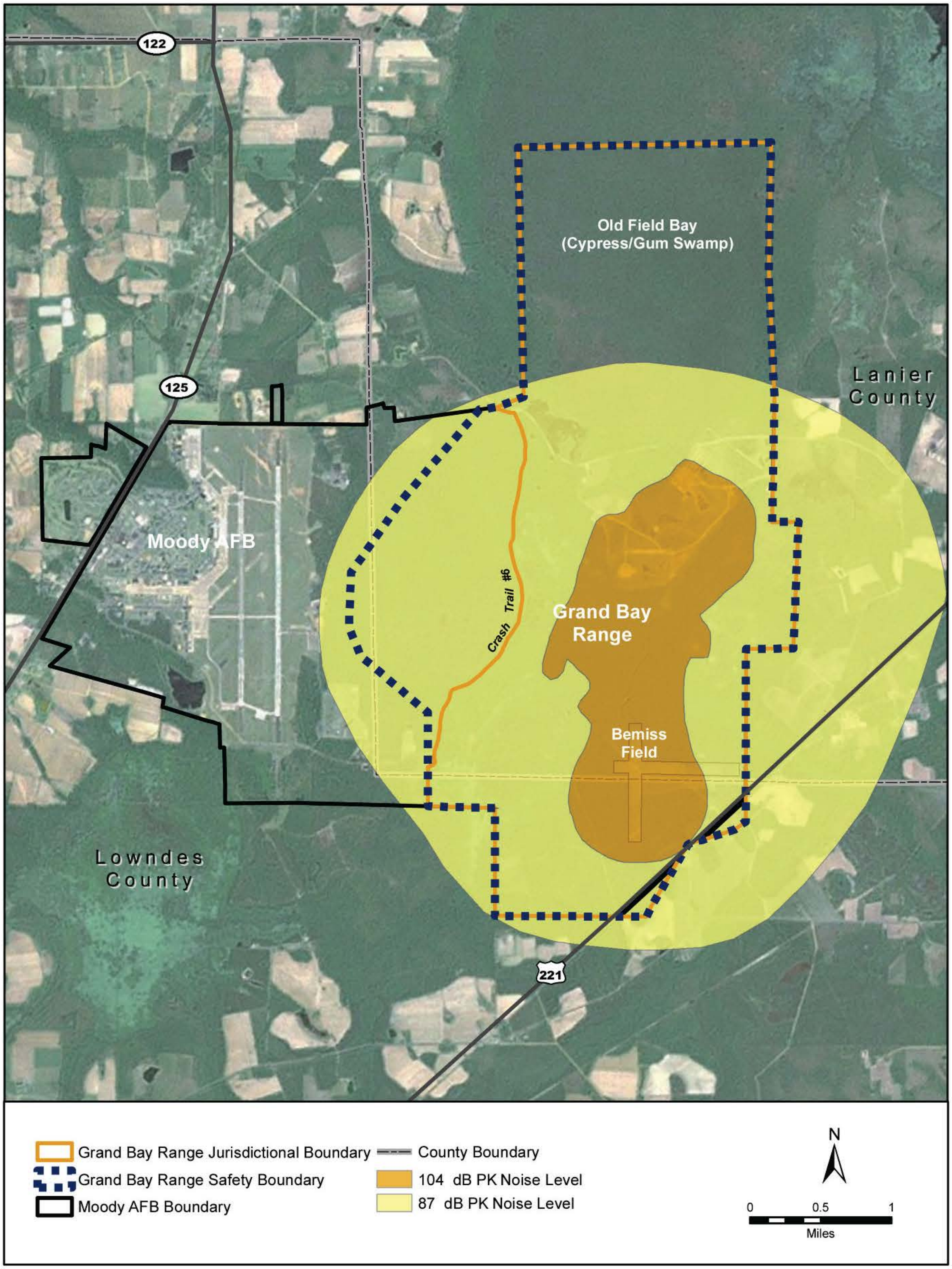


Figure 3-5. Noise Contours for all Ground-Based Small Arms Operations at the Grand Bay Range Impact Area and Bemiss Field under Alternatives 1 and 2

Under Alternatives 1 and 2, using this conservative noise modeling approach, residences located southeast of Bemiss Field would experience PK15(met) noise levels between 87 and 104 dB (i.e., Noise Zone II). In addition, since it was estimated 80 percent of these ground-based operations would occur between 7:00 a.m. and 10:00 p.m., these noise levels can be expected to occur about 20 percent of the time between 10:00 p.m. and 7:00 a.m. According to the guidelines in AR 200-1, Noise Zone II represents a potential for incompatible land use with a relatively low risk of generating noise complaints. Using aerial imagery, it appears up to four homes are located south of Old State Road within the off-base Noise Zone II area; no schools or hospitals are located within the area. While there are no air-to-ground baseline noise contours from which to make a comparison, noise exposure from air-to-ground training and aircraft-generated noise levels from overflights has affected neighboring residents for years. While there would be an increase in noise levels generated by ground-based small arms operations, the increase would not be at such a level to introduce new incompatibilities with land use near the range. However, noise complaints can be anticipated to increase. The human and/or natural environment would not be exposed to adverse health risks.

For EOD, no changes to the number or type of ordnance used would occur under Alternatives 1 or 2. Therefore, noise impacts under Alternatives 1 and 2 would remain the same as presented in Figures 3-3 and 3-4. The EOD Flight would continue to operate in the same manner as presented under baseline conditions, including providing the public prior notification of the semi-annual range clearance involving 450-lb bombs.

3.3.2.2 No Action Alternative

Under the No Action Alternative, Grand Bay Range, Bemiss Field, and EOD range operations would continue conducting operations at current levels using existing target and training areas. Thus, baseline conditions presented under Affected Environment would persist under the No Action Alternative.

3.4 HAZARDOUS MATERIALS AND WASTE, TOXIC SUBSTANCES, AND CONTAMINATED SITES

Hazardous Materials. Hazardous materials are chemical substances that pose a substantial hazard to human health or the environment. They are regulated under several federal programs administered by the USEPA, including the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (U.S. Code, Section 9601 *et. seq.*), Emergency Planning and Community Right-to-Know Act (42 U.S. Code 11001 *et seq.)*, Toxic Substances Control Act (TSCA) (15 U.S. Code 2601, *et seq.)*, and the Resource Conservation and Recovery Act (RCRA) (42 U.S. Code 6901, *et seq.)*. DoD installations are required to comply with these laws along with other applicable federal, state, and DoD regulations, as well as with relevant EOs including EO 13148, *Greening the Government Through Leadership in Environmental Management*.

Hazardous Waste. In regulations promulgated under RCRA, the USEPA defines hazardous waste as a solid waste which is not excluded from regulation as a hazardous waste under 40 CFR 261.3(b) and exhibits any of the characteristics (ignitability, corrosivity, reactivity, and toxicity) described in 40 CFR

261.3(a); or is listed in 40 CFR 261 Subpart D; or is a mixture containing one or more listed hazardous wastes. Hazardous wastes may take the form of solid, liquid, contained gaseous, semi-solid wastes (e.g., sludges), or any combination of wastes that pose a substantial present or potential hazard to human health or the environment and have been discarded or abandoned. Military munitions used for their intended purposes on ranges or collected for further evaluation and recycling are not considered waste per the Military Munitions Rule (MMR) (40 CFR 266.202). The MMR amended portions of RCRA (40 CFR Parts 260 through 270) and defines when conventional and chemical military munitions become solid waste potentially subject to RCRA.

Toxic Substances. The promulgation of TSCA (40 CFR Parts 700-766) represented an effort by the federal government to address those chemical substances and mixtures for which it was recognized that the manufacture, processing, distribution, use, or disposal may present unreasonable risk of personal injury or health of the environment, and to effectively regulate these substances and mixtures in interstate commerce. The TSCA Chemical Substances Inventory lists information on more than 62,000 chemicals and substances. Toxic chemical substances regulated by USEPA under TSCA include lead, which for the purposes of this EA, is evaluated in the most common form found in ordnance.

Contaminated Sites. Potential hazardous waste contamination areas are being investigated as part of the Defense Environmental Restoration Program (DERP). The DoD developed the DERP to identify, investigate, and remediate potentially hazardous material disposal sites on DoD property prior to 1984. As part of DERP, the DoD has created the Environmental Restoration Program (ERP) and the Military Munitions Response Program (MMRP). Under the MMRP, closed historic ranges and munitions disposal sites are required to have discarded military munitions, unexploded ordnance, and their chemical residues disposed and site cleaned up. The MMRP must also address the unique explosive safety hazards associated with munitions and explosives and human health risks posed by munitions constituents at locations not designated as operational ranges. There are no historic closed ranges associated with Grand Bay Range.

3.4.1 Affected Environment

The affected environment for this resource includes the facilities where hazardous materials and wastes are generated and disposed of, as well as where contaminated sites would be disturbed.

Hazardous Materials. Moody AFB has implemented a Hazardous Materials Pharmacy (HAZMART) to manage the purchasing and distribution of hazardous materials. Moody AFB also implements pollution prevention measures to minimize the use of hazardous materials including inventory reduction or elimination, product substitution, recycling, and reuse.

Hazardous Waste. Moody AFB is a permitted as a large-quantity generator of hazardous waste operating under permit GA0570024109 (USEPA 2011a). Hazardous wastes generated at the base are primarily associated with the maintenance and operation of military aircraft. Typical hazardous wastes from range operations include waste paint, contaminated rags, batteries, fuels, oils, and degreasers. Hazardous wastes are collected in 55-gallon metal drums or other suitable containers. Currently, Moody AFB has one 90-

day hazardous waste storage facility which is operated and managed by a private contractor (Moody 2011b). Grand Bay Range has one satellite accumulation point.

Moody AFB has implemented a Hazardous Waste Management Plan that identifies hazardous waste generation areas and addresses the proper packaging, labeling, storage, and handling of hazardous waste. The plan also addresses record keeping, spill contingency and response requirements, and education and training requirements. Procedures and responsibilities for responding to a hazardous waste spill or other incident are described further in the Moody AFB Integrated Contingency Plan.

Toxic Substances. Bullets are often fragmented and pulverized upon impact with the ground, backstops, berms, or bullet traps; as a result, antimony, copper, lead, and zinc contribute to small arms munitions constituent soil loading.

3.4.2 Environmental Consequences

The magnitude of potential impacts associated with hazardous materials and wastes depends on the toxicity, transportation, storage, and disposal of these substances. The threshold of significance would be met if hazardous materials and hazardous waste substantially increase the human health risk or environmental exposure through storage, use, transportation, or disposal of these substances. An increase in the quantity or toxicity of hazardous materials and/or hazardous waste handled by a facility may also signify a potentially adverse effect, especially if a facility was not equipped to handle the new waste stream. For contaminated sites, impacts would be adverse if the contaminated site was disturbed or there was a change in its remediation status.

3.4.2.1 Action Alternatives

Hazardous Materials. It is anticipated that there would be a slight increase in the amount of hazardous materials under Alternatives 1 and 2 due to increase in hazardous materials associated with maintenance operations. However, any increase is expected to be negligible since the range currently conducts maintenance operations. In addition, procedures for hazardous material management established for Moody AFB would continue to be followed. The elimination and/or reduction of the hazardous substances through pollution prevention strategies would reduce the overall amount of hazardous materials used, thus minimize the overall potential impacts to the environment. Therefore, there would be negligible impacts to hazardous materials from implementation of Alternatives 1 or 2.

Hazardous Waste. Under Alternatives 1 and 2, there would be an increase in generation of hazardous waste due to expanded range operations. Military munitions used for their intended purposes on ranges or collected for further evaluation and recycling are not considered waste per the MMR. Other hazardous waste, such as those associated with maintenance related operations are anticipated to be minor since the range currently conducts maintenance operations. Moreover, Moody AFB would continue to operate within its large-quantity generator hazardous waste permit conditions. Established hazardous waste procedures would continue to be followed during future operations that occur in association with Alternatives 1 and 2. Therefore, there would be negligible impacts to hazardous waste from implementation of Alternatives 1 or 2.

Toxic Substances. An increase in ground-based operations involving live fire would contribute to small arms munitions constituent soil loading of antimony, copper, lead, and zinc. However, these metals generally tend to adhere to soil grains and organic material and remain fixed in shallow soils (U.S. Army 2005). Refer to Sections 3.7.2.1 and 3.9.2.1 for additional information on impacts to soils and water resources. During range clearance operations, ejected munitions casings and other range debris is inspected, demilitarized (if necessary), certified as inert, and disposed of either by recycling or transfer to a landfill permitted to accept such waste. It is anticipated that current procedures would continue to be followed. Therefore, there would be negligible impacts to toxic substances from implementation of Alternatives 1 or 2.

3.4.2.2 No Action Alternative

Under the No Action Alternative, Grand Bay Range, Bemiss Field, and EOD range operations would continue at current levels at existing target and training areas. All regulations and plans that pertain to hazardous material, hazardous waste, toxic substances, and contaminated sites would continue to be followed. Thus, baseline conditions would persist under the No Action Alternative.

3.5 PUBLIC SAFETY AND OCCUPATIONAL HEALTH

The Air Force practices Operational Risk Management as outlined in AFI 90-901, *Operational Risk Management Requirements,* provide for a process to maintain readiness in peacetime and achieve success in combat while safeguarding people and resources. The safety analysis contained in this section addresses issues related to the health and well-being of both military personnel and civilians located in the vicinity of or on the Grand Bay Range, Bemiss Field, or EOD Range. The primary safety concern with regard to training operations is associated with ground, flight, and explosive safety. Ground safety considers issues associated with operations and maintenance activities that support range operations, including fire response. Flight safety considerations address aircraft mishaps and Bird/Wildlife Aircraft Strike Hazards (BASHs). Explosive safety discusses the management and use of ordnance or munitions associated with training activities. Please refer to the May 2012 Final Environmental Assessment Addressing the Expansion of Sortie-Operations at Moody AFB, incorporated by reference, for analysis of flight safety considerations (U.S. Air Force 2012).

3.5.1 Affected Environment

The ROI includes the portions of Grand Bay Range where military personnel and aircraft conduct range operations.

Ground Safety. With exception of all-terrain vehicles, vehicle use is primarily restricted to existing roads and trails; all-terrain vehicles are authorized for off-road use in upland areas only. Vehicle mishaps on the range are primarily limited to getting stuck on semi-prepared roads and training areas. In addition, some of the roads have limited visibility due to the close proximity of trees, brush, and road configuration (e.g., sharp turns) (Tillman 2012).

In regards to wildland fire safety, specific procedures are implemented for minimizing the risk of fire from range operations. When a high fire potential has been declared, the Range Control Officer (RCO) notifies 23 WG OSS/OSKR, which, in turn, notifies scheduled range users and flying units of the hazard and resultant operational limitations (i.e., cold spots required, no pyrotechnic materials allowed, etc.). During dry periods, specific targets and ranges with a high fire risk are continuously evaluated for the safety of planned operations. In the event of a large fire on the range, the RCO will close the range and notify all appropriate organizations. Any pilot observing a fire on or near the range complex is required to notify the RCO immediately.

Ordnance Safety. On Grand Bay Range, use of ordnance during training is limited to designated impact areas. Ordnance currently used at the range includes training and inert bombs and gun and cannon ammunition fired from aircraft and helicopters. The use of live ordnance is currently prohibited on Grand Bay Range. The predominant training bomb used on the range is BDU-33. This is a small training bomb weighing approximately 25 pounds, composed of ferrous metals and equipped with a small spotting charge that serves as an aid for visual scoring of delivery accuracy. Range training operations are covered under AFI 13-212, *Range Planning and Operations*; ACC Supplement 1, *Weapons Ranges*; Air National Guard Instruction 13-312, and Grand Bay Range local supplements. Supplement 1 identifies responsibilities and defines operating criteria for both routine and emergency situations at Grand Bay Range. Safety standards require safeguards on weapons systems and ordnance to ensure against inadvertent releases. All munitions mounted on aircraft are equipped with mechanisms that preclude release or firing without activation of an electronic arming circuit.

In accordance with AFI 13-212, the range impact area is cleared on a regular basis. Trained EOD personnel inspect all debris. If items are deemed hazardous or unknown, EOD uses a small charge to eliminate the danger of explosion.

Hazard areas, which is the composite area of all surface danger zones (SDZs) and weapon danger zones (WDZs) for all authorized weapon delivery events against targets approved for actual expenditures of ordnance, are developed using the Range Managers Toolkit (RMTK). The RMTK consists of a suite of tools (e.g., SDZ tool, WDZ tool, etc.) designed to assist Range Managers with daily operations and planning. SDZs define the ground and airspace designated within the installation boundary for vertical and lateral containment of projectiles, fragments, debris, and components resulting from the firing, launching, or detonation of weapon systems to include explosives and demolitions. The SDZ tool generates the worst-case scenario. WDZs identify the minimum area necessary to contain munitions and hazardous fragments within the installation boundary that results from aviation delivered ordnance. The WDZ tool determines aircraft type, ordnance, and delivery parameters. AFI 13-212 requires a 99.9999 percent level of containment for surface fires, 99.999 percent for aviation gun ammunition, and 99.99 percent for all other aviation-delivered ordnance. Range operations currently conducted are done so in accordance with AFI 13-212.

3.5.2 Environmental Consequences

This section addresses potential impacts to safety from implementation of the Proposed Action. The issues that have a potential to affect safety are evaluated relative to the degree to which the activity increases or decreases safety risks to military personnel, the public, and property. Issues addressed in this section are ground safety (including fire resulting from an aircraft mishap); flight safety (including mishap and BASH potential), and explosives safety. The potential for the Proposed Action to increase these risks is assessed, as well as the Air Force's capability to manage these risks.

3.5.2.1 Action Alternatives

Ground Safety. Under the Proposed Action, there would be no changes to ground safety procedures in regards to vehicle safety and wildland fire safety. Small arms tracer munitions cause half or more of all ignitions on most military live-fire ranges (DoD 2012a). The Army conducted an experiment from July 2010 to March 2012 to better establish the conditions under which ignitions from tracer rounds are likely so as to more accurately assess the fire risk posed by them (DoD 2012b). At the end of the experiment, it was determined two significant explanatory variables were fuel moisture and wind speed, whereas fuel moisture had the strongest effect (DoD 2012a). As described in Moody AFB's INRMP, wildfire intensity on the installation is minimized because of the reduction of fuel loads (i.e., the dry weight of fuels [woody or other vegetation] in any given area) through prescribed burning, the thinning and management of commercial forest stands, and the creation and annual maintenance of permanent firebreaks throughout the installation (Moody AFB 2006). Since activities at Grand Bay Range and Bemiss Field would continue to be conducted using the same processes and procedures as under current operations, implementation of Alternatives 1 or 2 would not result in significantly increased ground safety risks.

Ordnance Safety. In accordance with AFI 13-212, new WDZ (for air-to-ground operations) and SDZs (for ground-based operations) have been generated for new ordnance proposed under Alternatives 1 and 2. A composite depicting these zones is shown in Figure 3-6. The Comprehensive Range Management Plan would be updated to reflect live fire being conducted at Grand Bay Range and Bemiss Field in accordance with AFI 13-212. All military personnel who operate, handle, transport, maintain, load, or dispose of missiles or explosives must be trained in accordance with all applicable DoD and Air Force regulations including AFI 91-201, *Explosives Safety Standards,* and AFI 91-202, *The U.S. Air Force Mishap Prevention Program*. In addition, in accordance with AFI 13-212, public access to the hazard area (i.e., the composite of all SDZs and WDZs) will be prohibited unless specifically authorized by range personnel, and all live munitions must be accounted for in the hazard area before public access is authorized.

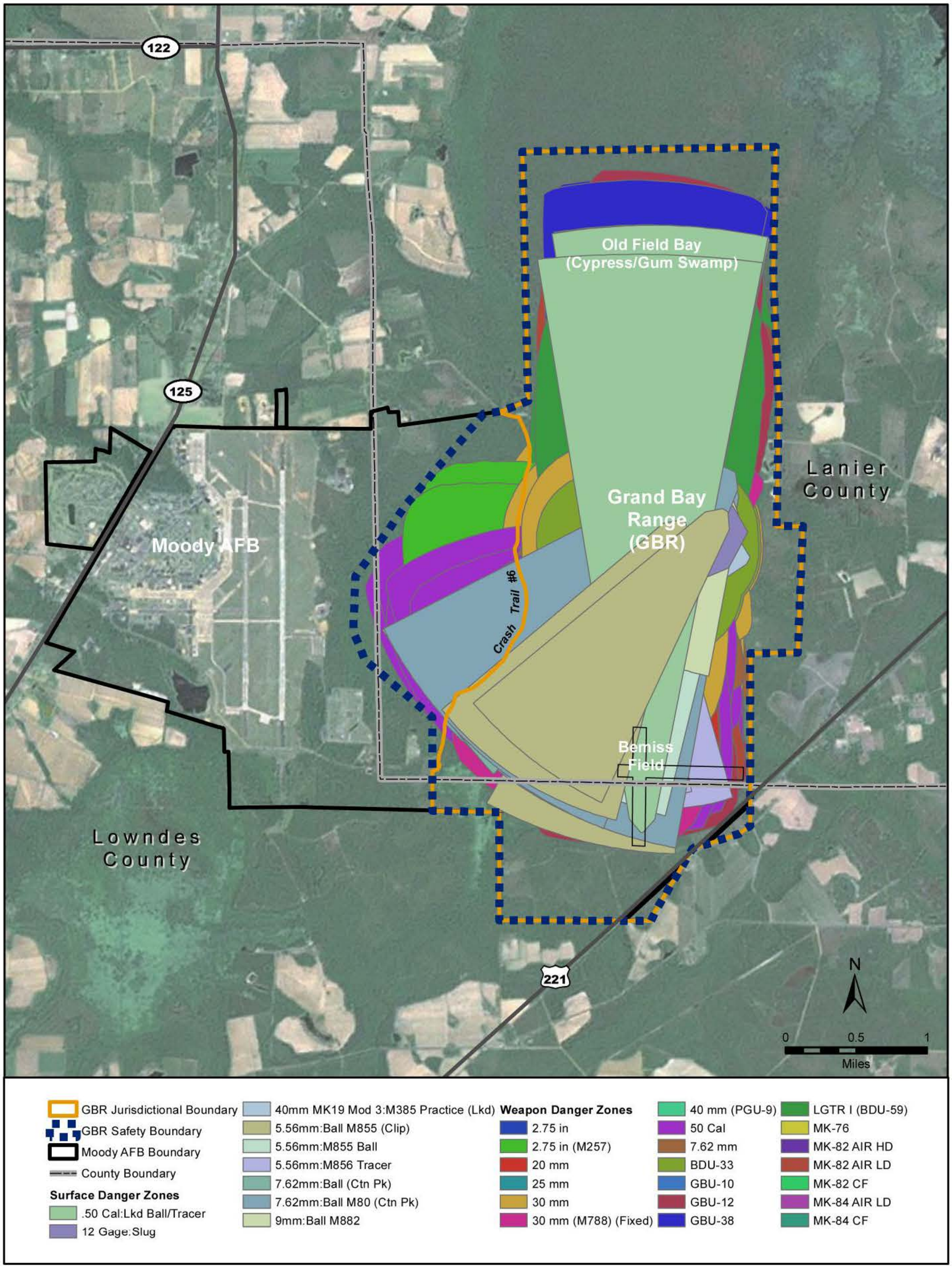


Figure 3-6. Weapon and Surface Danger Zones

With respect to ordnance on the aircraft, there are several electro-mechanical safeguards specifically designed to prevent the accidental, inadvertent, or un-commanded release of ordnance. While the occurrence of an accidental release is not impossible, it is highly improbable. Alternatively, there is the potential for a commanded release to be ineffective, resulting in "hung" ordnance. In such an event, the RCO would direct the pilot to follow "hung ordnance" procedures. If these were ineffective, the pilot would be directed to avoid overflight of populated areas and return to a military location where ordnance technicians could dispose of the ordnance.

In conclusion, implementation of Alternatives 1 or 2 would not result in significant safety concerns.

3.5.2.2 No Action Alternative

Under the No Action Alternative, Grand Bay Range, Bemiss Field, and EOD range operations would continue at current levels at existing target and training areas. All regulations and plans that pertain to ground, flight, and explosives safety would continue to be followed; thus, baseline conditions would persist under the No Action Alternative.

3.6 RECREATIONAL RESOURCES

This section addresses natural resources and man-made facilities designated or available for public recreational use. The setting, activity, and other elements that characterize affected recreational areas are considered in order to assess potential impacts. This EA focuses on outdoor recreational because there would be no potential for effects (i.e., no change to on-base population) to any other indoor-related activities.

3.6.1 Affected Environment

The affected environment for outdoor recreation for this EA consists of Grand Bay Range. Grand Bay Range is combined with state-owned and state-leased property to the south of Moody AFB to form the Grand Bay WMA. The Range comprises 5,874 acres or 71.9 percent of the WMA (Moody AFB 2007a).

Grand Bay Range recreational activities are co-managed by GA DNR under an Air Force license agreement for fish and wildlife management purposes. A Memorandum of Understanding (MOU) between GA DNR and Moody AFB establishes that Grand Bay Range may be incorporated into the Grand Bay WMA for the purposes of wildlife management and outdoor recreation by public entities (GA DNR 2007). Moody AFB has the right to restrict access to the licensed areas at any time for national security purposes or to fulfill the mission of the Installation.

Grand Bay Range is open to the general public for hunting during specified weekends, which are determined and published/posted by the GA DNR in the Georgia Hunting Seasons and Regulations (GA DNR 2011). Deer, turkey, small game, alligators, and waterfowl hunting are permitted seasonally throughout the year and allowed only when Grand Bay Range is not being used for military training. All portions of Grand Bay Range (with the exception of the impact areas), Dudley's Hammock, and the EOD Range are open for hunting. The impact areas are fenced off and marked with signs specifying where access ends. Hunters receive a map of permitted hunting areas upon check-in at the WMA entrance (Lee

2011). Annually, the WMA is available approximately 56 days for hunting activities (Moody AFB 2007a).

3.6.2 Environmental Consequences

Impacts to recreation include consideration of three variables: 1) resource sensitivity (the rarity and importance of a recreational resource within the area of potential effect), 2) resource quantity (opportunities for similar recreational experiences within the area of potential effect), and 3) resource quality (the recreational experience offered is unique to the area of potential effect). Impacts to recreation are generally considered significant if a designated federal, state, regional, or local park or preservation area is affected in a manner that reduces the amount of land available for recreation or the inherent value of recreation use is diminished for the long term.

3.6.2.1 Action Alternatives

Implementation of Alternatives 1 and 2 has the potential to affect recreation resource quantity by reducing the number of weekend days the Range would be open to the public for hunting. It is anticipated that implementing Alternatives 1 or 2 would result in more weekend closures than under the No Action Alternative. The impact to hunters is difficult to predict precisely because hunting is allowed based on specified seasons prescribed by GA DNR. Generally, these seasons occur in March through May (turkey), August to February (small game), September through October (alligator), September through December (waterfowl), and September through January (deer). If in fact Grand Bay Range is closed to hunting during specified hunting seasons, the number of hunting days available would be reduced from the current average of 56 days.

The Range would continue to work closely with GA DNR to minimize the number of weekend days the Range would be closed to hunting. However, the prime mission of the Range is to provide air-to-ground training for Air Force pilots and personnel. The reduction in hunting availability could be viewed as a potential negative impact for hunters because the nearest WMAs offering similar hunting opportunities at little or no cost, are over 80 miles away (i.e., Dixon Memorial and Flat Tub WMAs). Other hunting opportunities in the Valdosta, GA area are also available through hunting leases and clubs and could be used by area hunters. Overall, Alternatives 1 and 2 would have minor to moderate adverse impacts on recreational opportunities and experiences at Grand Bay Range.

3.6.2.2 No Action Alternative

Under the No Action Alternative, Grand Bay Range, Bemiss Field, and EOD range operations would continue at current levels at existing target and training areas. The public would continue to access Grand Bay Range for hunting at similar levels. Thus, baseline conditions would persist under the No Action Alternative.

3.7 GEOLOGICAL RESOURCES

Geological resources are defined as the geology, topography, and soils of a given area. The geology of an area includes bedrock materials, mineral deposits, and fossil remains. Topography refers to terrain, dominant landforms, and other visible features. Soils are unconsolidated materials on or near the surface and are defined by classifications and associations. A soil classification is a broad term for the general type of soil found in a larger area (i.e., hydric, alluvial, or clay soils). Soil associations are site-specific based on the particular soil type or complex found at that location.

3.7.1 Affected Environment

The ROI for geological resources consists of all target and impact areas within Grand Bay Range, inclusive of Bemiss Field and the EOD range.

Geology and Topography. Moody AFB is located within the Georgia Lower Coastal Plain. The predominant landform in this area consists of moderately dissected, irregular plains of marine origin formed by deposition of continental sediments onto the submerged shallow continental shelf, which was later exposed when the sea receded from this area. The most important stratigraphic unit is the Suwannee Limestone, which contains the upper portions of the Floridan Aquifer. This layer ranges in thickness from approximately 200 to 250 ft and is usually less than 200 ft below ground surface.

The eastern portion of Moody AFB, Grand Bay Range, is primarily located in a low area known as Grand Bay Swamp. Land surface elevations on Moody AFB vary from its lowest point on the eastern portion at approximately 190 ft MSL to about 240 ft MSL near the center of the base. Slopes range from 0 to 5 percent. Moody AFB also contains karst topographical traits. Karst topography is marked by circular depressions formed from groundwater erosion of the underlying limestone. The depressions, also known as lime sinks or sinkholes, vary greatly in size and depth and are partially filled with alluvium from the surrounding uplands. Some sinkholes contain large amounts of peat and are often inundated with water throughout the year. These characteristics exist at Moody AFB due to the thinner overburden materials and higher elevations of the underlying limestone layers. Consequently, testing of soil stability and load bearing capacity is a requirement before implementing any construction project (Moody AFB 2007a).

Bemiss Field is situated on a relatively level plateau at an elevation of approximately 200 ft MSL. There is no exposed limestone or other noteworthy geologic features.

Soils. Soils found within Moody AFB are associated Tifton Upland District with the Tifton Upland District of the Lower Coastal Plain. Characteristics of this region include well-drained soils and slopes generally ranging from 0 to 12 percent; slopes at Moody AFB range from 0 to 5 percent. The upland soils were formed from deep sedimentary sands and clays and lower alluvial soils were formed from eroded uplands. The two most dominant soil associations on Moody AFB include the Tifton-Pelham-Fuquay and the Dasher associations. The majority of the main base consists of the Tifton-Pelham-Fuquay association containing soils with a sandy surface layer and loamy subsoil (i.e., soil composed of a mixture of sand, clay, silt, and organic matter). Tifton and Fuquay soils are generally located along the ridges, and Pelham soils are located in drainages and periodically inundated depressions.

Hydric soils cover at least 60 to 70 percent of Grand Bay Range. The Dasher association covers the majority of Grand Bay Range and consists of soils in marshes, swamps, and drainageways. These soils are very poorly drained with the surface layer consisting of approximately 8 inches of mud deposits. The underlying organic material extends to a depth of 75 inches or more. Most of the undeveloped areas on the eastern portion of the Installation, including Grand Bay Range and Bemiss Field, consist of generally poorly drained organic soil in swamps, marshes, and poorly defined drainages (Moody AFB 2007a).

Bemiss Field consists predominantly of Mascotte soils, which are characterized as hydric soils with a sandy surface layer and loamy or sandy subsoil and are found on flats and in depressions and drainages. Additional soil types within Bemiss Field include Pelham to the south of the proposed runway, Olustee to the northeast, and Leefield to the southwest; all of which are considered hydric soils. Pelham soils are poorly drained and nearly level. Leefield soils have a sandy surface layer and loamy subsoil and are found on low uplands and in depressions. Olustee is a poorly drained sandy soil located on flats (Moody AFB 2007a).

3.7.2 Environmental Consequences

Topography and geology would not be affected by implementation of Alternatives 1 or 2. As such, this analysis will only focus on potential impacts to soils. Impacts to soil would be considered significant if they would cause erosion that would result in an appreciable loss of topsoil. Impacts to topography would only be significant if they result in accelerated soil erosion resulting in an appreciable loss of topsoil.

3.7.2.1 Action Alternatives

Under both Alternatives 1 and 2, many operations, including security forces training, drop zone-related actions, and helicopter landing/hovering actions do not involve ground disturbance. In addition, with exception of all-terrain vehicles, vehicle use is primarily restricted to existing roads and trails. All-terrain vehicles are authorized for off-road use in upland areas only. EOD range detonations would continue to occur in specially designed bunkers, and no ground disturbance is associated with these activities. In addition, under Alternatives 1 and 2, air-to-ground operations would continue to be conducted at designated areas within the Grand Bay Range Impact Area.

Under Alternatives 1 and 2, additional and ground-based operations involving live fire would occur at the Grand Bay Range Impact Area and Bemiss Field. Specifically, ordnance types would include live fire using 9 mm, 7.62 mm, 5.56 mm, 12 gauge, and .50 cal rounds. Bullets are often fragmented and pulverized upon impact with the ground, backstops, berms, or bullet traps; as a result, antimony, copper, lead, and zinc contribute to small arms munitions constituent soil loading. These metals generally tend to adhere to soil grains and organic material and remain fixed in shallow soils (U.S. Army 2005). In general, however, lead and copper have the lowest potential for mobility, while antimony has moderate mobility, and zinc has the highest mobility in soil. Copper and zinc have relatively low toxicity and pose a relatively low risk to migration. Although antimony has relatively high toxicity, it has moderate mobility in soil and is generally found in low concentrations on ranges. Therefore, antimony does not appear to produce a significant exposure risk in transport pathways (U.S. Army 2005). As such, this analysis will focus on lead, which has a relatively high toxicity and higher potential to be detected in transport pathways.

Factors influencing whether or not lead is transported away from the impact area include soil characteristics and the condition of the munitions round. Most of the undeveloped areas on the eastern portion of the Installation, including Grand Bay Range and Bemiss Field, consist of generally poorly drained organic soil in swamps, marshes, and poorly defined drainages (Moody AFB 2007a). Intact rounds and rounds fragmented into relatively large pieces will not be easily moved by runoff or wind and present the least human exposure risk, since exposure to metals with these physical characteristics presents a low probability for bioaccessibility. Conversely, small-sized lead particles can be easily transported by wind or storm water as a suspended solid, and bioaccessibility may become an issue if an exposure pathway exists. In general, 9-mm pistol rounds will stay intact upon impact with the soil and are usually found with little to no deformation or fragmentation. The human exposure risk associated with these rounds in the environment is typically very small. On the other hand, rifle rounds (e.g., 5.56 mm, 7.62 mm, and 0.50 cal) travel at much higher velocities and will impact the ground with much more force. At relatively short distances (82 to 656 ft), these rounds will often fragment into very small particle sizes upon impact with the soil. Beyond these distances, there is less fragmentation, resulting in large metal fragments and intact rounds. Based on visual observations, the degree of fragmentation appears to be more a function of distance from the firing point as opposed to the type of soil into which the round is being fired (U.S. Army 2005).

Under both Alternatives 1 and 2, Moody AFB would continue to comply with National Pollutant Discharge Elimination Systems permit and Georgia Erosion and Sediment Control Act regulations. Moody will also continue implementing BMPs such as maintaining vegetative buffers, streamside management zones, and other measures which would minimize the potential for soil erosion and sedimentation. In addition, range operations would adhere to requirements within AFI 13-212, *Range Planning and Operations*, which provides guidance for the planning, operations, management, safety, equipment, facilities, and security of Air Force ranges. If Alternatives 1 or 2 is selected, an operational range assessment would be completed to assess the potential for off-range migration of munitions constituents from live fire during range operations in accordance with DoD Directive 4715.11, *Environmental and Explosives Safety Management on Operational Ranges within the United States,* and the Air Force Operational Range Assessment Plan. With compliance with DoD and Air Force requirements, no significant impacts to soil are anticipated with the implementation of Alternatives 1 or 2.

3.7.2.2 No Action Alternative

Under the No Action Alternative, Grand Bay Range, Bemiss Field, and EOD range operations would continue at current levels at existing target and training areas. All regulations and plans that pertain to controlling erosion and sedimentation would continue to be followed. Thus, baseline conditions would persist under the No Action Alternative.

3.8 BIOLOGICAL RESOURCES

Biological resources include living, native, or naturalized plant and animal species and the habitats within which they occur. Plant associations are referred to as vegetation and animal species are referred to as wildlife. Habitat can be defined as the resources and conditions present in an area that produces occupancy of a plant or animal (Hall *et al*. 1997). Although the existence and preservation of biological resources are intrinsically valuable, these resources also provide aesthetic, recreational, and socioeconomic values to society. This analysis focuses on species or vegetation types that are important to the function of the ecosystem, of special societal importance, or are protected under federal or state law or statute. For purposes of the EA, these resources are divided into four major categories: vegetation; wetlands and freshwater resources; wildlife; and threatened, endangered, or sensitive species.

Vegetation includes all existing terrestrial plant communities with the exception of wetlands or threatened, endangered, or sensitive species.

Aquatic and Wetland habitats are considered sensitive and subject to federal regulatory authority under Section 404 of the CWA and EO 11990, *Protection of Wetlands*. Jurisdictional wetlands are defined by the U.S. Army Corps of Engineers (USACE) as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (USACE 1987). Areas meeting the federal wetland definition are under the jurisdiction of the USACE.

Wildlife includes all vertebrate animals with the exception of those identified as threatened, endangered, or sensitive. Wildlife includes fish, amphibians, reptiles, birds, and mammals.

Sensitive species are defined as those plant and animal species listed as threatened, endangered, or proposed as such, by the U.S. Fish and Wildlife Service (USFWS) or GA DNR. The ESA protects federally listed threatened and endangered plant and animal species. For the Proposed Action and alternatives, GA DNR through the Georgia Natural Heritage Program (GA NHP) also protects state-listed plant and animal species through their respective state fish and wildlife and administrative codes.

3.8.1 Affected Environment

The affected environment for biological resources under this proposal consists of all target and impact areas within Grand Bay Range, inclusive of Bemiss Field and the EOD range.

Vegetation. Moody AFB is located in southern Georgia within the Outer Coastal Plain Forest province of the U.S. lowland ecoregion. Grand Bay Range contains a wide variety of habitats, including extensive areas of wetlands. Wetlands are typically vegetated with a scrub-shrub cover type; wetter areas transition into a black gum-cypress (*Nyssa sylvatica*) swamp association with pockets of open water. The black gum-cypress swamp association is primarily vegetated with an overstory of black gum and cypress, but contains significant numbers of red maples (*Acer rubrum*) and sweetbays (*Magnolia virginiana*). The understory vegetation is moderately dense and consists of heaths, redbay (*Persea palustris*), wax myrtle (*Myrica cerifera*), cinnamon fern (*Osmunda cinnamomea*), chain fern (*Woodwardia virginica*), and greenbrier (*Smilax* spp.). In the transition areas from wetlands to uplands, pond pine (*Pinus serotina*), slash pine (*Pinus elliotii*), and dense thickets of evergreen shrubs and palmetto (*Serenoa repens)* become more predominant as the soils transition from hydric to mesic. Eventually, the upland areas are comprised predominantly of a pine forest type, established either through natural community succession or through artificial regeneration (i.e., pine plantations) (Moody AFB 2007a).

Bemiss Field was active during the 1940s as an auxiliary airstrip to Moody AFB. In addition to its current uses described in Section 2.2, a ULZ was approved for Bemiss Field in 2008 and constructed in 2011. The ULZ runs north-south and is 4,100 feet (ft) long and 75 ft wide (U.S. Air Force 2008). The pine forest that surrounds Bemiss Field is composed mostly of loblolly pine (*Pinus taeda*), longleaf pine (*Pinus palustris*), and slash pine (Moody AFB 2007a).

The Grand Bay Range impact area and Bemiss Field are managed to provide a Bahia grass monoculture to minimize the potential for wildlife interactions with aircraft. The GA DNR maintains wildlife openings in the vicinity and immediately adjacent to Bemiss Field. These 0.5- to 1-acre openings provide forage for wildlife species (Moody AFB 2007a), and are used concurrently for military training activities.

Aquatic and Wetland Habitats. Exclusive of the Okefenokee Swamp, the Grand Bay/Banks Lake wetland complex of over 13,000 acres is the largest freshwater lake/swamp system in the coastal plain of Georgia. This complex is composed of several broad Carolina bays (1 to 4 miles across), which are collectively referred to as "Grand Bay," and shallow lakes, interconnected by cypress-black gum swamp (Moody AFB 2007a). Open water in this area is primarily confined to Banks Lake, which occupies about 13 square miles; however, only about 25 percent of Banks Lake has open water, and the remainder is classified as marsh, scrub-shrub, and hardwood wetlands (Moody AFB 2007a). About 2,180 acres of the lake lie within the Grand Bay Range boundaries. Shiner Pond, which is located along the central-northern boundary of Moody AFB, is approximately 65 acres but contains vast areas with cypress trees and other vegetative cover.

Water flow through Grand Bay is generally southeastern and southward. The northern parts of Banks Lake and approximately one-third of the shrub swamp area known as Old Field Bay drain to the northeast into Mill Creek, a tributary of Big Creek, which discharges to the Alapaha River and ultimately into the Suwannee River. Between Old Field Bay and Grand Bay lies a system of open marsh and creek swamp. Watersheds from the two bays converge here to form Grand Bay Creek, the major surface water collector for the wetlands complex. Southern parts of Banks Lake, and the remainder of Grand Bay, drain to the southeast through Grand Bay Creek. Grand Bay Creek also flows into the Alapaha River (Moody AFB 2007a). Overall, there are about 4,511 acres of wetlands within the Grand Bay Range jurisdictional boundary (Figure 3-7).

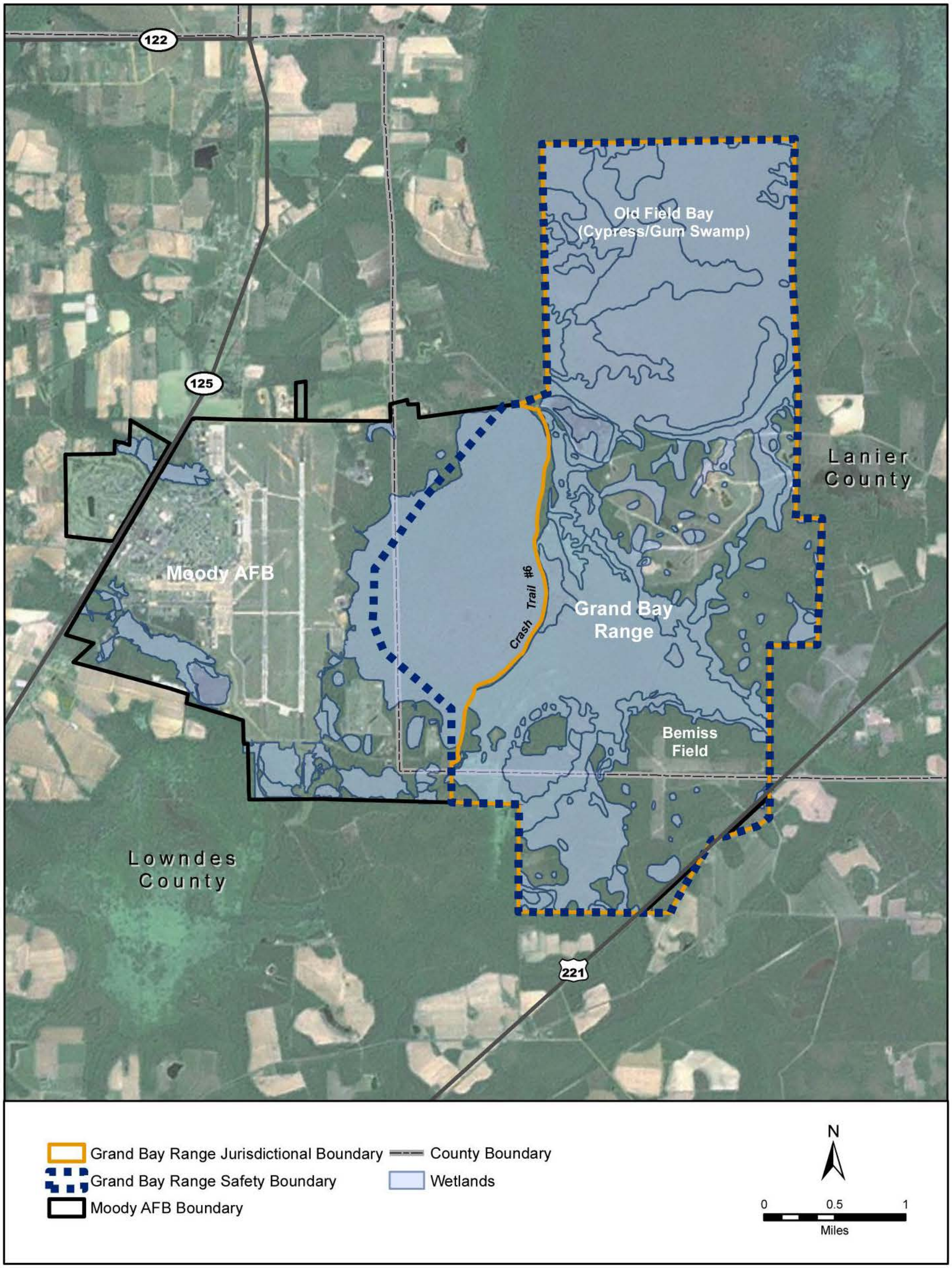


Figure 3-7. Grand Bay Range Wetlands

Wildlife. The pine flatwoods and extensive aquatic and wetland areas that dominate Grand Bay Range and Bemiss Field support a variety of fish and wildlife species. The undeveloped areas provide resting and overwintering habitat for several species of ducks, including ring-necked duck (*Aythya collaris*), American wigeon (*Anas americana*), green-winged teal (*Anas crecca*), blue-winged teal (*Anas discors*), and bufflehead (*Bucephala albeola*). Wood duck (*Aix sponsa*) are present in fair numbers during winter migration, as well as during the summer months. In addition, the wetland areas support large rookeries of wading bird species, including great blue heron (*Ardea herodias*), little blue heron (*Egretta caerulea*), black-crowned night heron (*Nycticorax nycticorax*), yellow-crowned night heron (*Nycticorax violaceus*), green heron (*Butorides virescens*), snowy egret (*Egretta thula*), great egret (*Ardea alba*), American bittern (*Botaurus lentiginosus*), least bittern (*Ixobrychus exilis*), and white ibis (*Eudocimus albus*). Other bird species commonly found within Grand Bay Range and Bemiss Field either as breeding residents or migratory visitors include turkey vulture (*Cathartes aura*), osprey (*Pandion haliaetus*), red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*Buteo lineatus*), wild turkey (*Meleagris gallopavo*), northern bobwhite (*Colinus virginianus*), common moorhen (*Gallinula chloropus*), blue jay (*Cyanocitta cristata*), Carolina wren (*Thryothorus ludovicianus*), northern mockingbird (*Mimus polyglottus*), mourning dove (*Zenaida macroura*), summer tanager (*Piranga rubra*), yellow warbler (*Dendroica petechia*), and several species of sparrows and wood warblers (Moody AFB 2007a).

Common mammals found at Grand Bay Range and Bemiss Field include Virginia opossum (*Didelphis virginiana*), eastern cottontail (*Sylvilagus floridanus*), gray fox (*Urocyon cinereoargenteus*), striped skunk (*Mephitis mephitis*), white-tailed deer (*Odocoileus virginianus*), eastern gray squirrel (*Sciurus carolinensis*), and eastern woodrat (*Neotoma floridana*). The wetland areas support a diverse assemblage of amphibian species including spring peeper (*Hyla crucifer*), southern chorus frog (*Pseudacris nigrita*), eastern newt (*Notophthalmus viridescens*), and tiger salamander (*Ambystoma tigrinum*). Reptiles found on the Installation include common box turtle (*Terrapene carolina*), ground skink (*Scincella lateralis*), eastern glass lizard (*Ophisaurus ventralis*), southern water snake (*Nerodia fasciata*), and rough earth snake (*Virginia striatula*) (Moody AFB 2007a).

Sensitive Species. There are no federally- or state-listed threatened or endangered plant species at Moody AFB (Moody AFB 2007a). Seven protected wildlife species are known to occur at Grand Bay Range (Table 3-5). The round-tailed muskrat (*Neofiber alleni)*, eastern indigo snake (*Drymarchon couperi*), and gopher tortoise (*Gopherus polyphemus*) are permanent residents while the bird species are all transient visitors. The eastern indigo snake, gopher tortoise, and bald eagle (*Haliaeetus leucocephalus)* are the only sensitive species actively managed at Moody AFB because these species are most likely to be affected by the military mission.

Table 3-5 Sensitive Wildlife Species Known to Occur at Grand Bay Range

Common Name	Scientific Name	Status	
		Federal	State
Reptiles			
American alligator	*Alligator mississippiensis*	T (S/A)	-
Eastern indigo snake	*Drymarchon couperi*	T	T
Gopher tortoise	*Gopherus polyphemus*	C	T
Birds			
Peregrine falcon	*Falco peregrinus*	-	E
Bald eagle	*Haliaeetus leucocephalus*	-	E
Wood stork	*Mycteria americana*	E	E
Mammals			
Round-tailed muskrat	*Neofiber alleni*	-	T

Notes: C = Candidate; E = endangered; S/A = similarity of appearance; T = threatened.
Sources: GA DNR 2009; Moody AFB 2007a; USFWS 2011a; USFWS 2011b.

The USFWS announced a 12-month finding on a petition to list the gopher tortoise as threatened and to designate critical habitat in the eastern portion of its range (i.e., east of the Mobile and Tombigbee Rivers) in the *Federal Register* on July 27, 2011 (USFWS 2011b). While the USFWS determined listing of the gopher tortoise in the eastern portion of its range is warranted, its listing is precluded by higher priority actions (USFWS 20011b). Therefore, for the purposes of this EA, the gopher tortoise remains a candidate species. There are seven gopher tortoise colonies at Moody AFB, three on main base and four within Grand Bay Range, consisting of 290 active burrows (Figure 3-8) (Moody AFB 2007a).

Exact census of gopher tortoise populations is difficult due to the relatively small amount of time tortoises spend outside of burrows. Therefore, burrow counts are typically used to determine population size. Gopher tortoise populations on Moody AFB have been monitored since 1995. Pedestrian surveys of suitable habitat are conducted annually to identify new gopher tortoise burrows, and all burrows are marked in the field, measured, and the position collected with GPS for incorporation into the Installation GIS database. The activity status of each burrow is collected annually and is used for making tortoise population estimates (Moody AFB 2007a). The gopher tortoise utilizes habitat that has well-drained, sandy soils in forest and grassy areas associated with pine overstory, open understory, and sunny areas for nesting (Moody AFB 2007a). In accordance with the C-130 Drop Zone USFWS Biological Opinion, dated 17 December 1996, Moody ABF personnel installed a chain link fence along the eastern border of Bemiss Field to limit gopher tortoise recolonization of the drop zone (USFWS 1996).

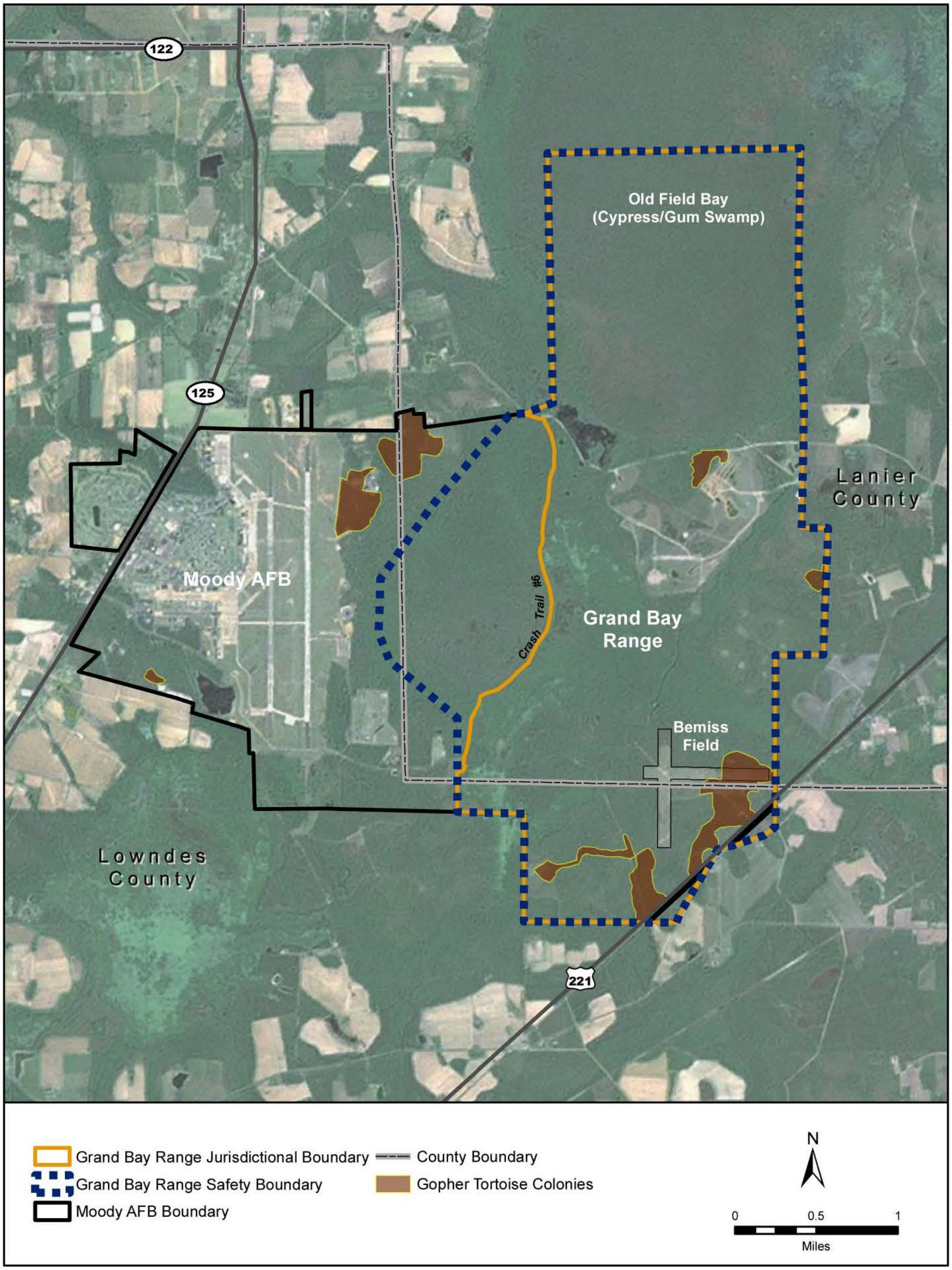


Figure 3-8. Gopher Tortoise Habitat on Grand Bay Range

Eastern indigo snakes are commonly associated with gopher tortoise burrows, especially during the winter when these burrows are used as refuge. Three sightings of indigo snakes were recorded in the eastern portion of Bemiss Field in 1991. In 1995, the GA DNR released two confiscated indigo snakes in a gopher tortoise colony at Bemiss Field. Subsequent sightings in 1996 of an adult and juvenile snake at Bemiss Field suggest that indigo snakes are reproducing in the vicinity of Bemiss Field or immigration has occurred in this area. No confirmed sightings of indigo snakes have occurred since 1996, despite intensive monitoring of gopher tortoise habitat and burrows for this species. Because eastern indigo snakes depend largely upon gopher tortoise burrows for shelter, management that increases suitability and extent of gopher tortoise habitat should benefit indigo snakes (Moody AFB 2007a).

Habitat management for gopher tortoises has included prescribed burning on a 2 to 3 year rotation, thinning of pine stands to open the canopy and increasing the amount of sunlight that reaches the ground, encouraging herbaceous growth, and the removal of midstory hardwoods and noxious vegetation (Moody AFB 2007a).

In 1987, the GA DNR discovered the round-tailed muskrat within the Grand Bay Range wetlands, including isolated wetlands in the impact area complex. The round-tailed muskrat, although similar in morphology and ecology to the common muskrat (*Ondatra zibethicus*), is found less often in open water and is more strictly nocturnal, with crepuscular activity peaks. Round-tailed muskrats are apparently colonial in both marshes and muck fields. Muskrats prefer early successional habitat comprised of a mosaic of open water, floating mat communities, and grass, sedge, and herbaceous communities. They are typically not found in areas with significant amounts of scrub-shrub or forested habitat. The round-tailed muskrat may wander or disperse a few or several hundred meters from permanent water.

Management of round-tailed muskrats is accomplished through affecting vegetation succession, primarily through the application of prescribed burning. From 1993 to 1994, The Nature Conservancy conducted comprehensive inventories for rare and endangered species as part of the Natural Heritage Inventory Report. The report concluded that in from 1993 to 1994, 60 houses (27 rats) existed in Moody Bay (Moody AFB 2007a).

The peregrine falcon (*Falco peregrinus)* was removed from the federal list of threatened and endangered species in 1999 due to its recovery; however, it is still listed as endangered by the State of Georgia. A threatened and endangered species survey was conducted by the Nature Conservancy from 1993 to 1994 and recorded the peregrine falcon during the fall and spring migratory seasons and is considered a seasonal visitor at the Installation (Moody AFB 2007a).

The bald eagle was delisted from the federal list of threatened and endangered species as of August 8, 2007 as is no longer protected by the Endangered Species Act. However, the species is protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act (USFWS 2011c).

Wood storks have been observed in several places on Moody AFB, including Grassy Pond, Lot Pond, Shiner Pond, Dudley's Hammock, and Grand Bay Creek and may occasionally forage at Grand Bay Weapons Range. Moody AFB has no permanent wood stork rookeries. They occur only sporadically on the Installation during the breeding season when habitat conditions are suitable for foraging in the Grand Bay-Banks Lake ecosystem. Wood storks feed in fresh and brackish wetlands and near cypress or other wooded swamps (Moody AFB 2007a).

The American alligator (*Alligator mississippiensis*) occurs at Moody AFB in wetland areas and is federally listed as threatened due to its similarity of appearance to the American crocodile (*Crocodylus acutus*), which is endangered (Moody AFB 2007a; USFWS 2011a).

3.8.2 Environmental Consequences

Determination of the significance of potential impacts to biological resources is based on: (1) the importance (i.e., legal, commercial, recreational, ecological, or scientific) of the resource; (2) the proportion of the resource that would be affected relative to its occurrence in the region; (3) the sensitivity of the resource to proposed activities; and (4) the duration of ecological ramifications. Impacts to biological resources are considered significant if species or habitats of concern are significantly affected over relatively large areas or disturbances result in reductions in the population size or distribution of protected species. Beneficial impacts are those that would improve or reduce the impacts to biological resources.

3.8.2.1 Action Alternatives

Vegetation. Under both Alternatives 1 and 2, forests on Grand Bay Range would continue to be used by security forces and rescue squadron personnel for ground-based training operations. Training activities in these areas typically consist of personnel movements in force on force training, land navigation, station training, air base defense training, pilot survival, and pilot rescue military training operations. While no vegetation removal is proposed under Alternatives 1 or 2, trees and shrubs in the new SDZs could be damaged from stray munitions. A figure (Figure 3-9) depicting the composite SDZs and the 2011 forest stand inventory was developed to determine the type and approximate acres of trees that fall within the new SDZs. As listed in Table 3-6, approximately 3,496 acres of trees from 25 stands (i.e., 1-49, 2-01, 2-02, 2-03, 2-08, 2-11, 2-14, 2-16, 2-17, 2-19, 2-23, 2-24, 2-25, 2-27, 2-28, 2-29, 2-33, 2-27, 2-39, 2-41, 2-43, 2-45, 2-47, 2-48, and 2-50) would be located within the SDZs. However, of the 25 stands that could be affected, 10 stands (2-01, 2-08, 2-11, 2-14, 2-16, 2-17, 2-19, 2-24, 2-39, and 2-50) of slash pine (transitional species), loblolly pine, longleaf pine, pond pine (transitional species), or water oak amounting to approximately 711 acres could be affected by being located within a SDZ. Specifically, as a result of live fire at the Grand Bay Range Impact Area and Bemiss Field, portions of these forested stands may become unsuitable for commercial timber harvest due to metal contamination, or become vulnerable to pest infestation resulting in tree death. The forests would continue to be managed for the continued use and enhancement as detailed in Moody AFB's INRMP. As such, no significant impact to vegetation would occur from implementation of Alternatives 1 or 2.

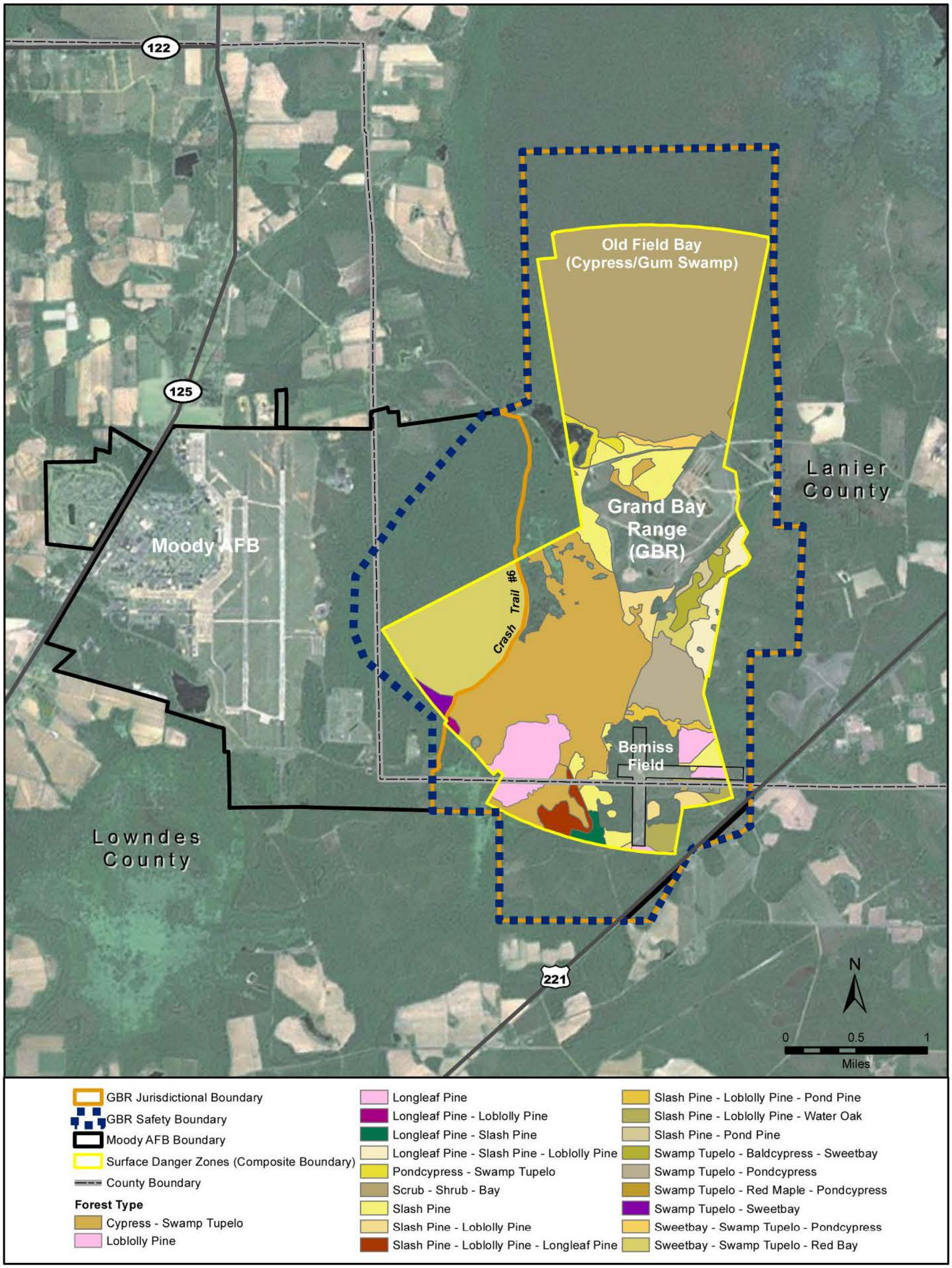


Figure 3-9. Composite Surface Danger Zones and Forest Type

Table 3-6 Composite Surface Danger Zone Forest Coverage

Forest Type	Firing Area		
	Impact Area	Bemiss Field	Total
Cypress - Swamp Tupelo	817.25	177.35	834.04
Loblolly Pine	159.75	0	159.75
Longleaf Pine	28.59	0	28.59
Longleaf Pine - Loblolly Pine	5.11	0	5.11
Longleaf Pine - Slash Pine	17.89	0	17.89
Longleaf Pine - Slash Pine - Loblolly Pine	79.29	1.69	79.29
Pond Cypress - Swamp Tupelo	0	25.93	25.93
Scrub - Shrub - Bay	0	1302.23	1302.23
Slash Pine	116.72	149.20	224.88
Slash Pine - Loblolly Pine	63.50	47.22	63.50
Slash Pine - Loblolly Pine - Longleaf Pine	44.53	0	44.53
Slash Pine - Loblolly Pine - Pond Pine	25.04	16.23	25.04
Slash Pine - Loblolly Pine - Water Oak	48.48	0.60	48.48
Slash Pine - Pond Pine	14.15	7.39	14.15
Swamp Tupelo - Bald Cypress - Sweetbay	49.17	25.13	49.17
Swamp Tupelo - Pond Cypress	147.22	98.79	147.22
Swamp Tupelo - Red Maple - Pond Cypress	0	2.27	2.27
Swamp Tupelo - Sweetbay	15.76	0	15.76
Sweetbay - Swamp Tupelo - Pond Cypress	0	18.71	18.71
Sweetbay - Swamp Tupelo - Red Bay	389.66	27.40	389.66
Total Forest Acres	**2,022.11**	**1,900.14**	**3,496.20**

Aquatic/Wetland Habitats. Under Alternatives 1 and 2, air-to-ground and ground-based training would continue to be conducted at designated range facilities as currently conducted. As discussed above and indicated in Table 3-6, new SDZs would affect up to 2,785 acres of wetland trees. In addition, live fire, including use of tracer rounds, is proposed under Alternatives 1 and 2. Please refer to Section 3.5.2.1 for a discussion of wildland fire risks and Section 3.7.2.1 for potential impacts to soils. In addition, Section 3.9.2.1 provides an analysis of potential impacts to water resources.

Wildlife. Under Alternatives 1 and 2, air-to-ground and ground-based training would continue to be conducted at designated range facilities as currently conducted. No ground disturbing activities would disturb wildlife habitat. In addition, live fire, including use of tracer rounds, is proposed under Alternatives 1 and 2. Please refer to Section 3.5.2.1 for a discussion of wildland fire risks, Section 3.7.2.1 for potential impacts to soils, and Section 3.9.2.1 for a discussion of potential impacts to water resources.

Implementation of Alternatives 1 and 2 would increase noise from human and operational activities. Human activities increasing noise would be military personnel moving to target locations new ground-based operations. Operational sources of noise would be associated with new ground-based operations under Alternatives 1 and 2 as compared to the baseline. Noise modeling results for operational sources of noise indicate an increase in the greater than 104 dBA PK15(met) noise exposure on Grand Bay Range and a small increase in the 87-104 dBA PK15(met) noise contour south of Bemiss Field.

Noise impacts on terrestrial animals can include changing habitat use and activity patterns, increasing stress response, decreasing immune response, reducing reproductive success, increasing predation risks, degrading conspecific communications, and damaging hearing (Pater *et al.* 2006). However, animals tend to be at little risk from hearing loss because they are seldom close enough to the source to be affected (Larkin 1994). In general, wildlife responses to various military activities have been difficult to quantify and may vary between species (Krausman *et al.* 2005). In addition, most quantitative studies regarding the potential mammalian wildlife responses to military activities have focused on low-altitude military aircraft overflights (Telesco and Van Manen 2006). A few studies on mammalian species such as black bears and Sonoran pronghorns found that these species did not appear to avoid habitat areas that were continuously disturbed by military activities (Telesco and Van Manen 2006; Krausman et al. 2005). Moreover, a few studies on birds indicated similar findings. Hayden *et al.* (2009) evaluated physiological response in free-living endangered and common passerine species to human disturbance. Specifically, one of the studies was designed to determine whether continuous human presence causes stress to vireos (black-capped and white-eyed) and golden-cheeked warblers to a human on foot continuously for 1 hour. After the 1 hour had passed, the birds were captured and its blood was analyzed for corticosterone; the results indicated there was no significant increase in plasma corticosterone concentrations. Therefore, it was concluded that while the 1 hour of constant human exposure altered the birds' behavior, there was no clear physiological stress response in these three birds (Hayden *et al.* 2009). In another study, the authors measured heart rate short after the start of a 4-hour case. In the white-eyed and black-capped vireos, there was an initial alarm response to the chase, but there was no evidence of elevated energetic costs to human disturbances (Hayden *et al.* 2009). In another study conducted between the DoD and USFWS, red-cockaded woodpeckers were found to successfully acclimate to military noise events (Pater *et al*. 1999). Regular intervals between firings that are perceived to be relatively constant should have less effect on wildlife than haphazardly-timed and varied sounds. In addition, cues appearing just before loud sounds (e.g., click of a weapon) might cause animals to temporarily vacate an area to reduce potential exposure (Larkin 1994).

It is important to note that Grand Bay Range and Bemiss Field areas are already subject to noise associated with aircraft operations (Moody AFB 2008c). Aircraft noise is generally thought to be the most detrimental during periods of stress such as winter, gestation, and calving (Pepper *et al.* 2003, DeForge 1981). Studies on the effects of aircraft noise on wildlife have been predominantly conducted on mammals and birds. Some studies have shown that the responses of large mammals to aircraft noise are transient and of short duration and suggest that animals acclimate to the sounds (Workman *et al*. 1992; Krausman *et al*. 1993, 1998; Weisenberger *et al*. 1996). Similarly, the impacts to raptors and other non-migratory birds (e.g., waterfowl, grebes) from aircraft low-level flights were found to be brief and not detrimental to reproductive success (Smith *et al*. 1988, Lamp 1989, Ellis *et al*. 1991, Grubb and Bowerman 1997). Refer to Appendix C for additional information.

Since Alternatives 1 and 2 would be implemented on an existing range, where the background noise and military activity levels are high, it is anticipated that wildlife present would generally be tolerant/acclimated to these noise and activity levels. Therefore, no significant impacts are anticipated to wildlife under Alternatives 1 or 2.

Sensitive Species. The eastern indigo snake, gopher tortoise, and bald eagle are the only sensitive species actively managed at Moody AFB because these species are most likely to be affected by the military mission. While the gopher tortoise is not currently federally listed under the Endangered Species Act, any Installation activity that occurs in or near gopher tortoise habitat is coordinated with the USFWS because of the close association between gopher tortoises and the federally threatened indigo snake.

As discussed above, studies regarding the potential wildlife responses to military activities have mainly focused on low-altitude military aircraft overflights (Telesco and Van Manen 2006). Some studies have shown that, in general, wildlife responses to aircraft noise are transient, short in duration, and dissipate quickly, suggesting that animals and birds acclimate to the sound. In addition, aircraft and air-to-ground ordnance noise is already a major component of existing conditions at the Range.

With regards to ground-operations, gopher tortoise habitat does exist on the Range, which is closely associated with the federally threatened indigo snake. Moody AFB has and will continue to conduct pedestrian surveys of suitable habitat on an annual basis. All burrows are marked in the field, measured, and its position collected. In addition, all-terrain vehicles are authorized for off-road use and the vehicle must maintain a 50-foot buffer around gopher tortoise burrows. Implementation of Alternatives 1 and 2 would have no effect on the eastern indigo snake.

While the bald eagle is no longer on the threatened and endangered species list, it remains protected from incidental take under the Federal Bald and Golden Eagle Protection Act. Management of bald eagles has been primarily focused on the protection of the single nest tree at the Grassy Pond Recreational Annex and improvement of foraging resources in Grassy Pond. With the concurrence of the USFWS, management zones have not been established around the nest site; however, the location of the nest is not provided to Installation personnel or the general public and no construction, timber harvesting, or other significant disturbance is allowed in areas near the nest. Monitoring of the bald eagle's behavior during normal operations indicates that these transient disturbances do not affect bald eagles or their reproduction success (Moody AFB 2007a). Therefore, implementation of Alternatives 1 or 2 would not result in the incidental taking of bald eagles.

At present, there is no critical habitat as defined in the Endangered Species Act located on Moody AFB. Therefore, the implementation of Alternatives 1 and 2 would have no effect on critical habitat.

3.8.2.2 No Action Alternative

Under the No Action Alternative, Grand Bay Range, Bemiss Field, and EOD range operations would continue at current levels at existing target and training areas. Vegetation, aquatic/wetland habitats, wildlife, and sensitive species on Moody AFB would continue to be managed pursuant to the Moody AFB INRMP and subsequent updates. Thus, baseline conditions would persist under the No Action Alternative.

3.9 WATER RESOURCES

Water resources for this EA include surface and storm waters, ground water, wetlands, and floodplains. Water resources are discussed in this EA because of the potential impacts to water quality. The CWA of 1972 (PL 95-217), the Safe Drinking Water Act of 1972 (PL 93-523) and Amendments of 1986 (PL 99-339), the Rivers and Harbors Act of 1899 and the Water Quality Act of 1987 (PL 100-4) are the primary federal laws protecting the nation's waters including lakes, rivers, aquifers, and wetlands.

3.9.1 Affected Environment

The affected environment for water resources is limited to lands potentially disturbed by Range operations.

Surface and Storm Water. Surface water includes streams, rivers, lakes, and reservoirs. Under the CWA, water bodies that do not meet their intended uses are included on the impaired waters list, referred to as the 303(d) list, and are required to have a Total Maximum Daily Load (TMDL) evaluation for the water quality constituent(s) in violation of the water quality standard. The TMDL process establishes the allowable pollutant loadings or other quantifiable parameters for a water body based on the relationship between pollutant sources and in-stream water quality conditions. This allows water quality based controls to be developed to reduce pollution and to restore and maintain water quality. There are no impaired waters located near Moody AFB.

Stormwater runoff, the part of the precipitation, snow melt, or irrigation water that appears in uncontrolled surface streams, rivers, drains, or sewers, can affect surface water quality by depositing sediment, minerals, or contaminants into surface water bodies. Stormwater runoff is influenced by meteorological factors such as rainfall intensity and duration, and physical factors such as vegetation, soil type, and topography.

Moody AFB is located within the Suwanee River Basin that ultimately discharges into the northeastern Gulf of Mexico. Major drainages within the basin that impact the Base include the Withlacoochee River to the west and the Alapaha River to the east. A major water feature of the basin is the Grand Bay-Banks Lake wetland complex that partially occurs within the Base boundaries. Banks Lake is located within the Banks Lake National Wildlife Refuge is approximately 1,255 acres and is the only major water body within the Grand Bay –Banks Lake complex. This complex is made up of several large Carolina Bays. A much smaller open water body called Shiner Pond is also located within the Grand Bay Range and is approximately 65 acres in size (Moody AFB 2007a).

All of the surface water features and wetlands are hydraulically connected to some extent through canals and man-made control structures. Surface water flow between the major water bodies at Moody AFB is driven by gravity with flow being generally southeastern and southward. The northern portions of Banks Lake drain towards the northeast into Mill Creek, then into the Alapaha River and ultimately to the Suwannee River. The Grand Bay watershed converges with the Old Field Bay watershed to form Grand Bay Creek a major surface water feature that drains the Grand Bay wetlands complex. Grand Bay Creek ultimately flows into the Alapaha River (Moody AFB 2007a).

Stormwater in the Grand Bay area is controlled by the use of man-made dikes and sills fitted with water control structures. Generally these structures are left in an open position to facilitate "natural" hydrologic flow of the area. Stormwater is controlled using the control structures but generally flows into the Grand Bay wetland complex (Moody AFB 2007a).

Groundwater. Groundwater is defined as subsurface water contained within aquifers. Groundwater aquifers are usually relatively deep under the ground surface.

At Moody AFB groundwater occurs within two major water bearing zones, the surficial aquifer system and the Floridan aquifer system. Generally groundwater is 10 to 20 ft below the ground surface. The surficial aquifer is composed of fine to coarse sands, gravels, silt, clayey silts, and clays. Groundwater quality is generally good with yields being usually less than 50 gallons per minute. The Floridan aquifer system is the primary water bearing formation within the general area around the Base. The Floridan aquifer provides almost all local water for commercial, industrial, domestic, irrigation, and municipal use. This aquifer typically has good water quality and plentiful yields. The groundwater from the Floridan is usually found at a depth of 150 feet below the ground surface and is usually under artesian conditions. Background groundwater analyses have confirmed several metals that naturally occur in the area of Moody AFB. Analyses have shown detectable levels of barium, cadmium, copper, iron, manganese, and zinc (Moody AFB 2007a).

Wetlands. EO 11990, Protection of Wetlands, directs federal agencies to take action to minimize the destruction, loss, or degradation of wetlands on their property and mandates review of proposed actions on wetlands through procedures established by NEPA. It requires that federal agencies establish and implement procedures to minimize development in wetlands.

Wetlands are generally considered to be transitional zones between the terrestrial and aquatic environments. Wetlands are defined as:

> "…those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (USEPA 2011b)."

Section 404 of the Clean Water Act regulates areas above mean high water and Section 10 of the Rivers and Harbors Act regulates areas below mean high water. Both regulations require a permit from the

USACE for discharges of dredged or fill material into waters of the U.S. Section 10 Waters are also regulated by the State of Georgia under the Coastal Marshlands Protection Act (OCGA 12-5-280).

The Grand Bay-Banks Lake wetlands complex that partially occupies Moody AFB's boundaries encompasses some 13,000 acres and is the largest freshwater lake/swamp system in the coastal plain of Georgia, save the Okefenokee Swamp. The complex is made up of six distinct Carolina Bays and shallow lakes that are interconnected through cypress-black gum swamp. As stated these bays are all somewhat hydraulically connected through natural canals and by man-made structures. The bays and lakes are separated by more than 5.7 miles of man-made earthen sills constructed by Moody AFB to allow emergency access into the wetlands. The wetland system is generally recharged by precipitation with most recharge occurring during the period of December through March when precipitation is high but evapotranspiration is low (Moody AFB 2007a).

Wetlands within the Grand Bay Range are made up of two types: palustrine and riverine wetlands. Palustrine wetlands are non-tidal wetlands dominated by trees, shrubs, persistent and non-persistent herbaceous plants, emergent mosses, or lichens. Riverine wetlands are those that occur within a defined water course, such as a stream channel. These wetlands are generally confined on the landward side by palustrine wetlands (Moody AFB 2007b).

Floodplains. EO 11988, Floodplain Management, sets forth the responsibilities of federal agencies for reducing the risk of flood loss or damage to personal property, minimizing the impacts of flood loss, and restoring the natural and beneficial functions of floodplains. This order was issued in furtherance of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The extent of the 100-year floodplains has not been mapped for Lanier County to date by the Federal Emergency Management Agency (FEMA). However, although the extent of floodplains present on Grand Bay Range is unknown, military construction and training activities consider the presence of floodplains and possible soil and flooding limitations prior to implementation of projects at Grand Bay Range (Moody AFB 2011b).

3.9.2 Environmental Consequences

Effects to water resources could result from erosion and runoff. Impacts to water resources could occur if implementation of any of the alternatives resulted in changes to water quality, threatened or damaged unique hydrologic characteristics, or violated established laws or regulations.

Impacts to water resources would be considered significant if there were chemical, physical, or biological effects that could be detectable and/or alter historical baseline or desired water quality conditions; and/or chemical, physical, or biological water quality standards/criteria on either a short-term or long-term basis. In addition, the Proposed Action would be considered adverse if it impacted a water body currently considered impaired under the CWA.

3.9.2.1 Action Alternatives

Surface and Storm Water. Under both Alternatives 1 and 2, many operations, including security forces training, drop zone-related actions, and helicopter landing/hovering actions do not involve ground disturbance. In addition, with exception of all-terrain vehicles, vehicle use is primarily restricted to existing roads and trails. All-terrain vehicles are authorized for off-road use in upland areas only. EOD range detonations would continue to occur in specially designed bunkers, and no ground disturbance is associated with these activities. In addition, under Alternatives 1 and 2, air-to-ground operations would continue to be conducted at designated areas within the Grand Bay Range Impact Area.

Under Alternatives 1 and 2, additional and ground-based operations involving live fire would occur at the Grand Bay Range Impact Area and Bemiss Field. Specifically, ordnance types would include live fire using 9 mm, 7.62 mm, 5.56 mm, 12 gauge, and .50 cal rounds. Bullets are often fragmented and pulverized upon impact with the ground, backstops, berms, or bullet traps; as a result, antimony, copper, lead, and zinc contribute to small arms munitions constituent soil loading. These metals generally tend to adhere to soil grains and organic material and remain fixed in shallow soils (U.S. Army 2005). In general, however, lead and copper have the lowest potential for mobility, while antimony has moderate mobility, and zinc has the highest mobility in soil. Copper and zinc have relatively low toxicity and pose a relatively low risk to migration. Although antimony has relatively high toxicity, it has moderate mobility in soil and is generally found in low concentrations on ranges. Therefore, antimony does not appear to produce a significant exposure risk in transport pathways (U.S. Army 2005). As such, this analysis will focus on lead, which has a relatively high toxicity and higher potential to be detected in transport pathways.

Factors influencing whether or not lead is transported away from the impact area include soil characteristics and the condition of the munitions round. Most of the undeveloped areas on the eastern portion of the Installation, including Grand Bay Range and Bemiss Field, consist of generally poorly drained organic soil in swamps, marshes, and poorly defined drainages (Moody AFB 2007a). Intact rounds and rounds fragmented into relatively large pieces will not be easily moved by runoff or wind and present the least human exposure risk, since exposure to metals with these physical characteristics presents a low probability for bioaccessibility. Conversely, small-sized lead particles can be easily transported by wind or storm water as a suspended solid, and bioaccessibility may become an issue if an exposure pathway exists. In general, 9-mm pistol rounds will stay intact upon impact with the soil and are usually found with little to no deformation or fragmentation. The human exposure risk associated with these rounds in the environment is typically very small. On the other hand, rifle rounds (e.g., 5.56 mm, 7.62 mm, and 0.50 cal) travel at much higher velocities and will impact the ground with much more force. At relatively short distances (82 to 656 feet), these rounds will often fragment into very small particle sizes upon impact with the soil. Beyond these distances, there is less fragmentation, resulting in large metal fragments and intact rounds. Based on visual observations, the degree of fragmentation appears to be more a function of distance from the firing point as opposed to the type of soil into which the round is being fired (U.S. Army 2005).

Although site specific sampling would be required to determine whether lead is actually be transported in the environment, potential minimization measures could be implemented to minimize adverse impacts to water quality. These include measures to prevent the migration of lead (e.g., collecting and disposing of ejected munitions casings and other range debris, vegetative solutions, stormwater BMPs, berms, etc.) and employing pollution prevention practices such as using bullet traps. Please note, however, that any future construction to minimize impacts from toxic substances, including berms and bullet traps, would require future analysis prior to their construction.

While there is a potential for moderate adverse impacts to water quality, Moody AFB would continue to operate within all permitted guidelines, adhere to the SWPPP, and conduct range operations in accordance with state and federal guidelines to ensure water quality was protected from possible impacts related to short- and long-term erosion and lead from spent munitions. This includes implementing project specific BMPs to minimize impacts to water quality. With implementation of minimization measures, there would be minor impacts to surface or storm waters from the implementation of Alternatives 1 or 2.

Groundwater. Under Alternatives 1 or 2, there would be no change in groundwater availability or supply. Any proposed increase in ground operations would occur in previously used areas and would not meaningfully increase impervious surfaces. Stormwater BMPs would continue to be used to appropriately direct surface waters to recharge areas. As such, no significant impacts to groundwater would occur.

Wetlands. Approximately 5,500 acres of jurisdictional and isolated wetlands are located within the boundaries of Moody AFB with the majority located in the central part of the Installation, and is part of the larger Grand Bay-Banks Lake wetlands complex, which extends north and south of the Installation. Military mission activities at Moody AFB rarely occur in wetlands, primarily because they are generally not suitable for military training. A Source Water Assessment project and a Watershed Assessment project were completed to determine the quality of these two resources. Results from these two studies indicate that Moody AFB training activities are not affecting surface waters.

Under Alternatives 1 and 2, additional and ground-based operations involving live fire would occur at the Grand Bay Range Impact Area and Bemiss Field. Specifically, ordnance types would include live fire using 9 mm, 7.62 mm, 5.56 mm, 12 gauge, and .50 cal rounds. For reasons described previously for surface and storm waters, depending on the manner in which ground operations occur, wetlands located on Grand Bay Range could be impacted by lead from expended casings. Site specific sampling would be required to determine whether lead is actually being transported in wetlands, potential minimization measures could be implemented to minimize adverse impacts to water quality. These include measures to prevent the migration of lead (e.g., collecting and disposing of ejected munitions casings and other range debris, vegetative solutions, stormwater BMPs, berms, etc.) and employing pollution prevention practices such as bullet traps. Although there is a potential for moderate adverse impacts to wetlands, Moody AFB would continue to operate within all permitted guidelines, adhere to the SWPPP, and conduct range operations in accordance with state and federal guidelines to ensure water quality was protected from possible impacts related to short- and long-term erosion and lead from spent munitions. This includes implementing project specific BMPs to minimize impacts to wetlands environments. With implementation of minimization measures, there would be minor impacts to surface or storm waters from the implementation of Alternatives 1 or 2.

Floodplains. No construction is proposed under the Proposed Action. As such, there would be no impact on human safety, health, and welfare; thus, no significant impacts to floodplains with the implementation of Alternatives 1 or 2.

3.9.2.2 No Action Alternative

Under the No Action Alternative, Grand Bay Range, Bemiss Field, and EOD range operations would continue at current levels at existing target and training areas. All regulations and plans that pertain to protecting water quality would continue to be followed; thus, baseline conditions would persist under the No Action Alternative.

3.10 CULTURAL AND TRADITIONAL RESOURCES

Cultural resources consist of prehistoric and historic districts, sites, structures, artifacts, or any other physical evidence of human activity considered important to a culture, subculture, or community for scientific, traditional, religious, or other reasons. Cultural resources can be divided into three major categories: archaeological resources (prehistoric and historic), architectural resources, and traditional cultural resources.

- Archaeological resources are locations where human activity measurably altered the earth or left deposits of physical remains (e.g. stone flakes, arrowheads, or bottles). Archaeological resources can include campsites, roads, fences, trails, dumps, battlegrounds, mines, and a variety of other features.
- Architectural resources include standing buildings, dams, canals, bridges, and other structures of historic or aesthetic significance.
- Traditional cultural resources can include archaeological resources, buildings, neighborhoods, prominent topographic features, habitats, plants, animals, and minerals that Native Americans and other groups consider essential for the continuance of traditional cultures.

Under the National Historic Preservation Act (NHPA), only significant cultural resources, known or unknown, warrant consideration with regard to adverse impacts from a Proposed Action. Archaeological and architectural resources generally must be more than 50 years old to be considered for protection under NHPA. However, more recent structures, such as Cold War era military buildings, may warrant protection if they are “exceptionally significant.” To be considered significant, archaeological or architectural resources must meet one or more criteria as defined in 36 CFR 60.4 for inclusion in the National Register of Historic Places (NRHP). These criteria include association with an important event, association with a famous person, embodiment of the characteristics of an important period in history, or the ability to contribute to scientific research. Resources must also possess integrity (i.e., their important historic features must be present and recognizable).

Traditional cultural resources can be evaluated for NRHP eligibility as well. However, even if a traditional resource is determined to be not eligible for the NRHP, it may still be significant to a particular community or American Indian tribe and protected under other laws and regulations discussed below. The significance of a traditional cultural resource is usually determined by consulting with the appropriate group.

3.10.1 Affected Environment

The affected environment for cultural and traditional resources consists of all target and impact areas within Grand Bay Range, inclusive of Bemiss Field and the EOD range. No traditional cultural resources, sacred sites, or Native American Graves Protection and Repatriation Act items have been identified at Moody AFB. In addition, no Cold War-era resources have been identified on Grand Bay Range (Moody AFB 2012b).

Grand Bay Range has been surveyed for its archeological and architectural resources. Archaeological investigations at Moody AFB to date have located two archaeological sites, 9LW52 and 9LW67 and 29 isolated finds on Grand Bay Range (Moody AFB 2012b; U.S. Air Force 2012). According to the Moody AFB ICRMP, Site 9LW52 remains unevaluated and Site 9LW67 is inconclusive for eligibility for the NRHP (Moody AFB 2012b). .

3.10.2 Environmental Consequences

Cultural resources are subject to review under a number of federal laws and regulations, including Section 106 of the NHPA of 1966 (as amended). Only cultural resources determined to be eligible or listed on the National Register are protected under the NHPA. In addition to affecting National Register listed or eligible resources, an alternative for implementing the Proposed Action that might affect traditional cultural properties protected under a number of other federal laws and by DoD policy warrants consideration.

For cultural resources significant impacts include adverse effects to the integrity of a historic property or a cultural resource that has not yet been evaluated to determine its eligibility to the National Register; the area of potential effect includes those sites experiencing ground disturbance from operational activities.

Analysis of potential impacts to cultural resources considers both direct and indirect impacts. Direct impacts may be the result of physically altering, damaging, or destroying all or part of a resource, altering characteristics of the surrounding environment by introducing visual or audible elements that are out of character for the period the resource represents, or neglecting the resource to the extent that it deteriorates or is destroyed. Direct impacts can be assessed by identifying the type and location of the Proposed Action and by determining the exact locations of cultural resources that could be affected. Indirect impacts are those that may occur as a result of the completed project, such as increased vehicular or foot traffic in the vicinity of the resource.

3.10.2.1 Action Alternatives

No known architectural, traditional cultural resources, and/or sacred sites have been identified and implementation of Alternatives 1 or 2 would not result in ground disturbance. Sites 9LW52 and 9LW67 are located outside the Proposed Action area and would not experience any ground-disturbance activities associated with range operations. If any cultural or traditional resources were discovered at a target or training areas, operations would cease and discovery would be immediately reported to Moody AFB's cultural resource department in accordance with the ICRMP guidance and procedures (Standard Operating Procedures 10 and 11, Moody AFB 2012b). Therefore, no adverse or potentially significant impacts would occur to cultural or traditional resources with implementation of either Alternative 1 or 2.

3.10.2.2 No Action Alternative

Under the No Action Alternative, Grand Bay Range, Bemiss Field, and EOD range operations would continue at current levels at existing target and training areas. Thus, baseline conditions would persist under the No Action Alternative.

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CHAPTER 4 CUMULATIVE EFFECTS

This section provides: 1) a definition of cumulative effects, 2) a description of past, present, and reasonably foreseeable actions relevant to cumulative effects, 3) an analysis of the incremental interaction the proposed action may have with other actions, and 4) an evaluation of cumulative effects potentially resulting from these interactions.

4.1 DEFINITION OF CUMULATIVE EFFECTS

CEQ regulations stipulate that the cumulative effects analysis within an EA should consider the potential environmental impacts resulting from "the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions" (40 CFR 1508.7). CEQ guidance in Considering Cumulative Effects affirms this requirement, stating that the first steps in assessing cumulative effects involve defining the scope of the other actions and their interrelationship with the proposed action. The scope must consider geographic and temporal overlaps among the proposed action and other actions. It must also evaluate the nature of interactions among these actions.

Cumulative effects are most likely to arise when a relationship or synergism exists between a proposed action and other actions expected to occur in a similar location or during a similar time period. Actions overlapping with or in close proximity to the proposed action would be expected to have more potential for a relationship than those more geographically separated. Similarly, actions that coincide, even partially, in time would tend to offer a higher potential for cumulative effects.

To identify cumulative effects the analysis needs to address three fundamental questions:

1. Does a relationship exist such that affected resource areas of the proposed action might interact with the affected resource areas of past, present, or reasonably foreseeable actions?
2. If one or more of the affected resource areas of the proposed action and another action could be expected to interact, would the proposed action affect or be affected by impacts of the other action?
3. If such a relationship exists, then does an assessment reveal any potentially significant impacts not identified when the proposed action is considered alone?

4.2 CUMULATIVE EFFECTS ANALYSIS

The scope of the cumulative effects analysis involves both the geographic extent of the effects and the time frame in which the effects could be expected to occur. For this EA, the ROI delimits the geographic extent of the cumulative effects analysis. The ROI includes the proposed action area (i.e., all target and impact areas at Grand Bay Range, inclusive of Bemiss Field and the EOD range), as well as immediate adjacent areas. The time frame for cumulative effects centers on the timing of the proposed action; specifically, existing training activities would continue with new operations continuing into the foreseeable future.

Another factor influencing the scope of cumulative effects analysis involves identifying other actions to consider. Beyond determining that the geographic scope and time frame for the actions interrelate to the proposed action, the analysis employs the measure of "reasonably foreseeable" to include or exclude other actions. For the purposes of this analysis, public documents prepared by federal, state and local government agencies form the primary sources of information regarding reasonably foreseeable actions. Documents used to identify other actions included notices of intent for EISs and EAs, management plans, land use plans, and other NEPA studies.

Due to the limited geographic scope and locally isolated environmental interactions that are anticipated, the ROI for this cumulative impacts analysis is the same for each resource as previously described in Chapter 3. For all alternatives, and for all resource categories, the potentially affected environment is Moody AFB and associated Grand Bay Range, Bemiss Field and the EOD Range.

Numerous other activities exist in the ROI. With exception of the EA for the Expansion of Sortie-Operations at Moody AFB (U.S. Air Force 2012), the past and present actions listed in Section 1.4.3, that have been incorporated by reference, have been included in the Proposed Action of this EA. (The Finding of No Significant Impact for this proposed action was signed in August 2012.) As described in the EA for the Expansion of Sortie-Operations at Moody AFB, sortie-operations would increase from 37,158 annual sortie operations to 52,426 annual sortie operations. In addition, the action proposes the use of flares at Moody AFB, as well as increase the expenditure of ordnance at Townsend Range (U.S. Air Force 2012). Although the noise associated with ordnance deployment differs from that associated with aircraft, there would be cumulative noise effects. However, it is not anticipated that when considered together these activities would impose adverse cumulative impacts to the natural or human environment. Therefore, this action is not carried forward for cumulative impact analysis.

Moody AFB proposes to prepare an EA to analyze the potential environmental impacts associated with certifying the Bemiss Field ULZ for use. The proposed action would include tree clearing, heavy weight drops, and increasing aircraft operations (these aircraft operations would be in addition to those previously analyzed in the May 2012 EA for the Expansion of Sortie-Operations at Moody AFB). As part of the tree clearing portion of the proposed project, obstructions within the maintained area would be removed, an exclusion area and clear zone would be established, and approach-departure obstructions would either be removed or mapped. While there would be noise associated with aircraft operations, for the reasons described above, no adverse cumulative noise impacts to the natural or human environment are anticipated. Range operations would continue to be managed in accordance with the Grand Bay Comprehensive Range Plan to ensure that operations are conducted in a safe, effective, and efficient manner. In addition, no tree clearing or vegetation removal is proposed under Alternatives 1 or 2. Therefore, no significant cumulative impacts would occur from implementation of this project.

Another project that is proposed for the future involves and changing the requirement for Restricted Areas R-3008A, B, and C from visual flight rules to visual flight rules-instrument flight rules. Changing the Restricted Areas requirement would allow greater flexibility in range operations involving aircraft as they would be able to occur in various weather conditions. Moody AFB is currently evaluating the level of required environmental analysis, but no cumulative impacts are anticipated from this project.

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CHAPTER 5 OTHER NEPA CONSIDERATIONS

5.1 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

Implementation of Alternatives 1 and 2 would not result in the unavoidable loss of any resources.

5.2 RELATIONSHIP BETWEEN SHORT-TERM USE OF THE HUMAN ENVIRONMENT, AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

NEPA requires analysis of the relationship between a project's short-term impacts on the environment and the effects those impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. Impacts that narrow the range of beneficial uses of the environment are of particular concern. This means that choosing one option may reduce future flexibility in pursuing other options, or that committing a resource to a certain use may eliminate the possibility for other uses of that resource.

Implementation of Alternatives 1 and 2 are not expected to result in impacts that would reduce environmental productivity, permanently narrow the range of beneficial uses of the environment, or pose long-term risks to health, safety, or the general welfare of the public.

5.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Primary irreversible effects result from permanent use of a nonrenewable resource (e.g., minerals or energy). Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the Proposed Action or consumption of renewable resources that are not permanently lost. Secondary impacts could result from environmental accidents. Natural resources include minerals, energy, land, water, forestry, and biota. Nonrenewable resources are those resources that cannot be replenished by natural means, including oil, natural gas, and iron ore. Renewable natural resources are those resources that can be replenished by natural means, including water, lumber, and soil. The action alternatives would involve minor commitments of irretrievable non-renewable and renewable resources, the magnitude of which depends on the alternative selected, and could involve negligible amounts of industrial resources such as capital, labor, and fuels.

EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, set goals for federal agencies in areas such as energy efficiency, renewable energy, toxic chemical reduction, recycling, sustainable buildings, electronics stewardship, and water conservation. EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, expands on the requirements set forth in EO 13423 and requires that all new construction comply with the *Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings*. This includes employing design and construction strategies that increase energy efficiency, eliminate solid waste, and reduce stormwater runoff. One strategy for reducing stormwater runoff is the implementation of LID technologies. As it pertains to this Proposed Action, EO 13423 sets as a goal for all federal agencies the improvement of energy efficiency and the "reduction of greenhouse gas emissions of the agency, through reduction of energy intensity by (i) 3 percent annually through the end of fiscal year 2015, or (ii) 30 percent by the end of fiscal year 2015, relative to the baseline to the agency's energy use in fiscal year 2003."

The Air Force has developed an energy plan to reduce energy demand, increase energy supply, and create a culture change where energy is a consideration in all actions (U.S. Air Force 2008d, 2010b). Implementation of this vision has resulted in a decrease in facility energy intensity by nearly 18 percent since 2003; reducing ground vehicle fleet fossil fuel consumption by 15 percent since 1999; purchasing over 190,000 Energy Star®-compliant computers since July 2007; and implementing cost efficiencies, such as reducing aircraft weight and optimizing flight routes, where mission appropriate. In addition, by 2016, the Air Force plans to cost effectively acquire 50 percent of contiguous U.S. aviation fuel via a synthetic fuel blend utilizing domestic feedstocks and produced in the U.S., with the intent to require that the synthetic fuel purchases be sourced from suppliers with manufacturing facilities that engage in carbon dioxide capture and effective reuse (U.S. Air Force 2008d). While the Proposed Action may contribute to the consumption of more nonrenewable resources, the energy resources required for range operations are not in short supply; their use would not have an adverse impact on their continued availability, and the energy resource commitment is not anticipated to be excessive in terms of region-wide usage. Compliance with the requirements set forth in EO 13423 would further minimize any irreversible or irretrievable effects to multiple non-renewable and renewable resources.

5.4 GREENHOUSE GAS EMISSIONS/GLOBAL CLIMATE CHANGE

Climate change refers to any significant change in the measure of climate lasting for an extended period of time and includes major changes in temperature, precipitation, or wind patterns that occur over several decades or longer (U.S. EPA 2012). Global warming is caused by natural and human factors. For the purpose of this cumulative impact analysis, focus will be on one human factor involving the release of GHG emissions. However, it is important to note that individual sources of GHG emissions are not large enough to have an appreciable effect on climate change. Therefore, an appreciable impact on global climate change would, if currently accepted predictions are accurate, only occur when proposed GHG emissions combine with other GHG emissions from other man-made activities on a global scale. While it is anticipated range operations do and would continue to produce GHG emissions, the overall amount of emissions is negligible and is not considered significant for the purposes of NEPA.

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APPENDIX A MAILING LIST AND COMMENTS RECEIVED ON THE DRAFT ENIVORNMENTAL ASSESSMENT

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The Draft Environmental Assessment (EA) and Draft Finding of No Significant Impact were made available to the general public and applicable government agencies for review and comment during the 30-day period that commenced with publication of the Notice of Availability in the *Valdosta Daily Times* on 17 May 2013. The 30-day public comment period ended on 17 June 2013. Copies of these documents were available at the Valdosta Lowndes County Library, 300 Woodrow Drive, Valdosta, GA 31602 and were sent directly to the following organizations received a copy of the Draft EA:

U.S. Environmental Protection Agency, Region 4
Attn: Mr. Heinz Mueller, Chief NEPA Program Office
Atlanta Federal Center
61 Forsyth Street
Atlanta, GA 30303-8960

U.S. Fish and Wildlife Service, Region 4
Attn: Mr. Richard Warner
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Georgia Department of Natural Resources
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Attn: Ms. DoraLyn Kirkland, Planning and Policy Advisor
2 Martin Luther King, Jr. Drive, SE, Suite 1152
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Atlanta, GA 30334-9000

Lanier County
Attn: Mr. Albert Studstill, County Administrator
100 Main Street
Lakeland, GA 31635

Lowndes County
Attn: Mr. Joseph Prichard, County Manager
327 N. Ashley Street, 3rd Floor
Valdosta, GA 31601

During the comment period, comments were received from the Georgia Department of Natural Resources, Environmental Protection Division. Based on the comments received, minor changes were incorporated into the Final EA. Refer to Table A-1 for a list of comments and their subsequent response; copies of all comments are included immediately following Table A-1.

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Table A-1 Comments and Responses to Comments Received on the Draft EA

Commenter	Comment/ Comment Summary	Action Taken to Address the Comment
Georgia Department of Natural Resources, Environmental Protection Division	Smokey SAMS (surface-to-air training missiles) were identified as a significant source of Perchlorate at Marine sites. The Grand Bay Range (GBR) supports Smokey SAMs (Page 3-8), which simulate an actual SAM deployment. However, there is no indication in the text of the EA as to whether the Smokey SAMs at GBR contain Perchlorate. Please indicate whether the Smokey SAMs used at GBR contain Perchlorate, and if so, please assess the impact of use of the Smokey SAMs on the environment.	Smokey SAMS are small unguided rockets used to visually simulate a surface-to-air missile and contain perchlorate. Although perchlorate is both a naturally occurring and man-made chemical, as discussed on Pages 3-3 to 3-4, the USEPA considers perchlorate an emerging contaminant and the agency is anticipating publication of a proposed rule for public review and comment in 2013. The text on Page 3-4 was revised to add additional information on Smokey SAMS and results of historic perchlorate sampling. Specifically, the following text was added and/or revised, "Smokey SAMS contain 238 grams of perchlorate in the propellant and is wholly consumed during the firing of Smokey SAMS. In the rare event of a dud or misfire, the Smokey SAM does not leave the launcher and is subsequently removed from the range. Historic sampling results taken from Moody AFB indicate the presence of perchlorate; however, the results were well below the USEPA and DoD Preliminary Remediation Goal of 15 parts per billion and no further action was needed (DoD 2013). Military range users and activities would be monitored, as deemed necessary, in accordance with applicable federal and state regulations."
Georgia Department of Natural Resources, Environmental Protection Division	Section 3.7 states that an operational range assessment (primarily for Lead) would be completed to assess the potential for off-range migration of MC from live fire during range operations in accordance with DoD Directive 4715.11. Therefore, the EA qualitatively evaluates MC as having no significant impact. Please indicate whether Georgia EPD will receive a copy of the range assessment for review.	The Air Force conducts periodic Range Assessment Reports that evaluates the Munitions Constituent Migration at Operational Ranges. The goal of the assessment report is to ensure the long-term viability of ranges. It utilizes a standardized and scientifically defensible methodology that is required for assessing off-range munitions constituent migration and for responding to any associated threats to human

Table A-1 Comments and Responses to Comments Received on the Draft EA

Commenter	Comment/ Comment Summary	Action Taken to Address the Comment
		health. The Air Force has funded the next full Range Assessment for Fiscal Year 2015. The Air Force is committed to working with its state and federal regulators and will share reports as they become available.
Georgia Department of Natural Resources, Environmental Protection Division	No evaluation of impacts to Geological Resources (Section 3.7) from additional explosive ordnance loading is provided in the Environmental Assessment. Please include a discussion on the impacts of the proposed operations on geological resources.	With exception of the introduction of live fire using 9 mm, 7.62 mm, 5.56 mm, 12 gauge, and .50 cal rounds, air-to-ground operations involving inert bomb dummy units and EOD range detonations would continue to occur in designated areas within the Grand Bay Range Impact Area. No impacts to geological resources are anticipated.
Georgia Department of Natural Resources, Environmental Protection Division	Section 3.9 identifies the groundwater surficial aquifer as being 10 to 20 feet below ground surface (bgs). The potential leaching of Munitions Constituents (MC) to the surficial aquifer is not assessed in the Environmental Assessment. Please include a discussion of the impacts of the proposed operations on groundwater resources from the leaching of MC from the soil.	Please refer to Section 3.9.2.1, Surface and Storm Water, for a discussion of potential impacts to surface and stormwater as a result of small arms munitions constituent soil loading.

-----Original Message-----
From: Amy Potter [mailto:Amy.Potter@dnr.state.ga.us]
Sent: Monday, June 17, 2013 5:37 PM
To: Santicola, Henry J Civ USAF ACC 23 CES/CEIEA
Cc: William Powell
Subject: Draft Environmental Assessment for Grand Bay Range, Bemiss Field, and EOD Range Operations

Dear Mr. Santicola:

Thank you for the opportunity to review the above referenced document. We have the following comments:

1) Smokey SAMS (surface-to-air training missiles) were identified as a significant source of Perchlorate at Marine sites. The Grand Bay Range (GBR) supports Smokey SAMs (Page 3-8), which simulate an actual SAM deployment. However, there is no indication in the text of the EA as to whether the Smokey SAMs at GBR contain Perchlorate. Please indicate whether the Smokey SAMs used at GBR contain Perchlorate, and if so, please assess the impact of use of the Smokey SAMs on the environment.

2) Section 3.7 states that an operational range assessment (primarily for Lead) would be completed to assess the potential for off-range migration of MC from live fire during range operations in accordance with DoD Directive 4715.11. Therefore, the EA qualitatively evaluates MC as having no significant impact. Please indicate whether Georgia EPD will receive a copy of the range assessment for review.

3) No evaluation of impacts to Geological Resources (Section 3.7) from additional explosive ordnance loading is provided in the Environmental Assessment. Please include a discussion on the impacts of the proposed operations on geological resources.

4) Section 3.9 identifies the groundwater surficial aquifer as being 10 to 20 feet below ground surface (bgs). The potential leaching of Munitions Constituents (MC) to the surficial aquifer is not assessed in the Environmental Assessment. Please include a discussion of the impacts of the proposed operations on groundwater resources from the leaching of MC from the soil.

If you have any questions, please contact Will Powell at 404-657-8680.

Amy M. Potter
Unit Coordinator, DoD Facilities Unit
Land Protection Branch
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APPENDIX B NOISE

APPENDIX B

Noise Background Information

Introduction

This appendix provides a general noise primer to educate the reader on what constitutes noise, how it is measured, and the studies that were used in support of how and why noise is modeled.

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B.1 BASICS OF SOUND

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air, and are sensed by the human ear. Whether that sound is interpreted as pleasant (e.g., music) or unpleasant (e.g., jackhammers) depends largely on the listener's current activity, past experiences, and attitude toward the source of that sound.

The measurement and human perception of sound involves three basic physical characteristics: intensity, frequency, and duration. The first characteristic, intensity, is a measure of the acoustic energy of the sound vibrations and is expressed in terms of sound pressure. Sound pressure increases as the amount of energy carried by the sound increases. As this energy increases, the human perception of that sound becomes louder. The second important physical characteristic of sound is frequency, which is the number of times per second that the air vibrates, or oscillates. Low-frequency sounds are exemplified by rumbles or roars, while high-frequency sounds are typified by sirens or screeches. The third important characteristic of sound is duration, or the length of time the sound can be detected.

The loudest sounds that can be detected comfortably by the human ear have intensities that are a trillion times higher than those of sounds that can barely be detected. This vast range means that using a linear scale to represent sound intensity is not feasible. As a result, a logarithmic unit known as the decibel (dB) is used to represent the intensity of a sound, also referred to as the sound level. A sound level of 0 dB is the approximate threshold of human hearing, and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB, and sound levels above 120 dB begin to cause discomfort to the human ear. Sound levels over 130 dB are felt as pain (Berglund and Lindvall 1995).

Sound levels cannot be arithmetically added or subtracted and are somewhat cumbersome to handle mathematically because of the logarithmic nature of the dB. However, some simple rules are useful when dealing with sound levels. First, if a sound's intensity is doubled, the sound level increases by 3dB, regardless of the initial sound level. For example:

60 dB + 60 dB = 63 dB, and

80 dB + 80 dB = 83 dB.

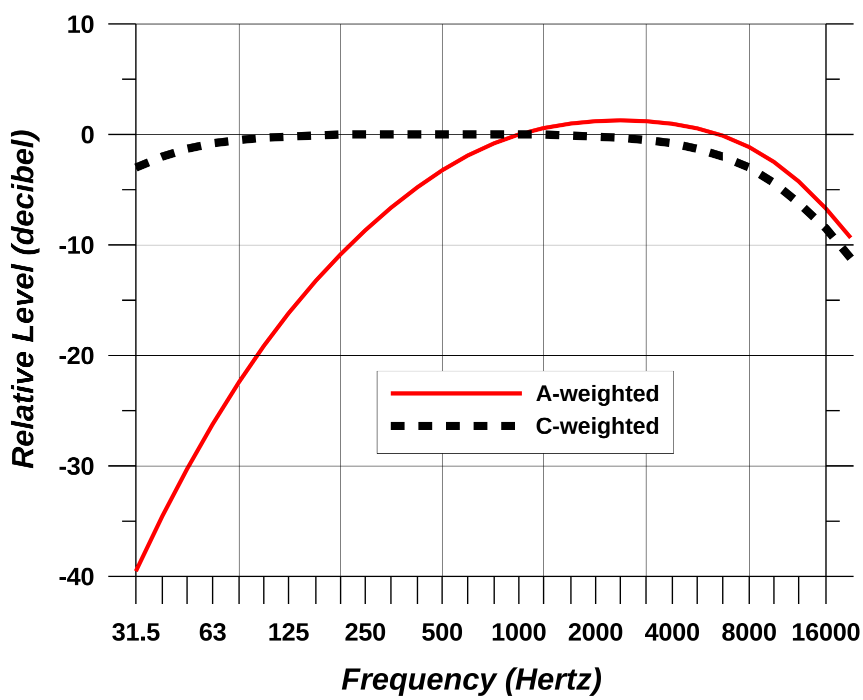
Second, the total sound level produced by two sounds of different levels is usually only slightly greater than the higher of the two. For example:

60.0 dB + 70.0 dB = 70.4 dB.

The addition of sound levels is often referred to as "decibel addition" or "energy addition." The latter term is derived from the process of adding dB values. First, each dB value is converted to its corresponding acoustic energy, and then those energies are added together using the normal rules of addition. Finally, the acoustic value is converted back into dBs.

The minimum change in the sound level of individual events that an average human ear can detect under normal listening conditions is about 3 dB. On average, a person perceives a change in sound level of approximately 10 dB as a doubling or halving of the sound's loudness. This relation holds true for loud and quiet sounds. A decrease in sound level of 10 dB actually represents a 90 percent decrease in the sound intensity, but there is only a 50 percent decrease in perceived loudness because of the nonlinear response of the human ear.

Sound frequency is measured in terms of cycles per second (cps), or hertz (Hz), the standard unit for cps. The normal human ear can detect sounds that range from approximately 20 Hz to 15,000 Hz. All sounds in this range of frequencies are not heard equally by the human ear, which is most sensitive to frequencies in the 1,000 to 4,000 Hz range. Weighting curves have been developed to correspond to the sensitivity and perception of different types of sound. A-weighting and C-weighting are the two most commonly used weightings. A-weighting accounts for frequency dependence by adjusting the very high and very low frequencies (below approximately 500 Hz and above approximately 10,000 Hz) to approximate the human ear's lower sensitivities to those frequencies. C-weighting is nearly flat throughout the range of audible frequencies. The two curves shown in Figure B-1 are adequate to quantify most environmental noises.



Source: ANSI S1.4A -1985 "Specification of Sound Level Meters"

Figure B-1

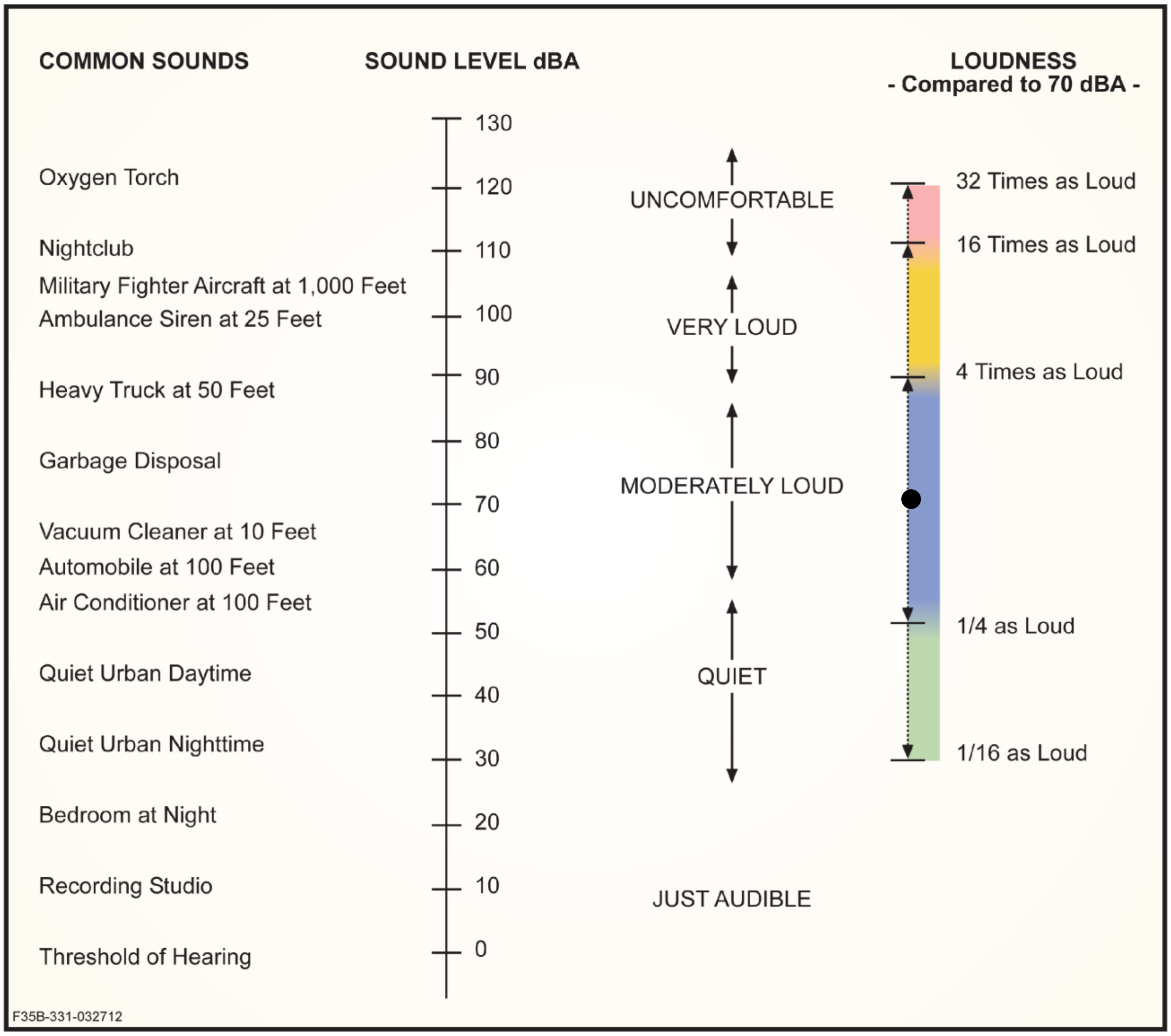
B.1.1 A-Weighted Sound Level

Sound levels that are measured using A-weighting, called A-weighted sound levels, are often denoted by the unit dBA or dB(A) rather than dB. When the use of A-weighting is implied, the adjective "A-weighted" is often omitted and the measurements are expressed simply as dB. In this report, dB units refer to A-weighted sound levels.

Noise becomes a potential issue when its intensity exceeds the ambient, or background, sound levels. Ambient background noise in metropolitan, urbanized areas typically varies from 60 to 70 dB, and can be as high as 80 dB or greater. Quiet suburban neighborhoods experience ambient noise levels of approximately 45-50 dB (USEPA 1978).

Figure B-2 is a chart of A-weighted sound levels from typical sounds. Some noise sources (air conditioner, vacuum cleaner) are continuous sounds that maintain a constant sound level for some period of time. Some (automobile, heavy truck) are the maximum sound produced during an event like a vehicle pass-by. Other sounds (urban daytime, urban nighttime) are averages taken over extended periods of time. A variety of noise metrics have been developed to describe noise over different time periods, as discussed below.

Aircraft noise consists of two major types of sound events: aircraft takeoffs and landings, and engine maintenance operations. The former can be described as intermittent sounds and the latter as continuous. Noise levels from flight operations that exceed background noise levels typically occur beneath main approach and departure corridors, in local air traffic patterns around the airfield, and in areas immediately adjacent to parking ramps and aircraft staging areas. As aircraft in flight gain altitude, their noise contributions drop to lower levels, often becoming indistinguishable from the background noise.



Source: Derived from the *Handbook of Noise Control,* Harris 1979, FICAN 1997.

Figure B-2

B.1.2 C-Weighted Sound Level

Sound levels that are measured using C-weighting, called C-weighted sound levels, are often denoted by the unit dBC. C-weighting is nearly flat throughout the audible frequency range. This weighting scale is generally used to describe high energy impulsive sounds, which are typically characterized by low frequencies. Impulsive sounds may induce secondary effects such as the shaking of a structure, rattling of windows, or the creation of vibrations. These secondary effects can cause additional annoyance and complaints.

The following definitions from the American National Standard Institute (ANSI) Standard S12.9, Part 4 provide general descriptions that are helpful in understanding impulsive sounds (ANSI 2005).

Impulsive Sound: Sound characterized by brief excursions of sound pressure (acoustic impulses) that significantly exceeds the ambient environmental sound pressure. The duration of a single impulsive sound is usually less than one second.

Highly Impulsive Sound: Sound from one of the following enumerated categories of sound sources: small-arms gunfire, metal hammering, wood hammering, drop hammering, pile driving, drop forging, pneumatic hammering, pavement breaking, metal impacts during rail-yard shunting operation, and riveting.

High-energy Impulsive Sound: Sound from one of the following enumerated categories of sound sources: quarry and mining explosions, sonic booms, demolition and industrial processes that use high explosives, military ordnance (e.g., armor, artillery and mortar fire, and bombs), explosive ignition of rockets and missiles, explosive industrial circuit breakers, and any other explosive source where the equivalent mass of dynamite exceeds 25 grams.

B.2 NOISE METRICS

A metric is a statistic for measuring or quantifying. Noise metrics help to quantify the noise environment. There are three families of noise metrics described below: one for single noise events such as an aircraft flyby, one for cumulative noise events such as a day's worth of aircraft activity, and one which quantifies the events or time relative to single noise events.

Within the single noise event family, metrics described below include Peak Sound Pressure Level (L_{pk}), Maximum Sound Level (L_{max}), and Sound Exposure Level (SEL). Within the cumulative noise events family, metrics described below include Equivalent Sound Level (L_{eq}), Day-Night Average Sound Level (DNL), and several others. With the events or time relative to single noise events family, metrics described below include Number of Events Above (NA) a Threshold Level (L) and Time Above (TA) a Specified Level.

B.2.1 Maximum Sound Level

The highest A-weighted integrated sound level measured during a single event in which the sound level changes value with time (e.g., an aircraft overflight) is called the maximum A-weighted sound level or L_{max}.

During an aircraft overflight, the noise level starts at the ambient, or background, noise level, rises to the maximum noise level as the aircraft flies closest to the observer, and then returns to the background noise level as the aircraft recedes into the distance. L_{max} indicates the maximum sound level that occurs for a fraction of a second. For aircraft noise, the time period over which L_{max} is derived is generally one-eighth of a second, and is denoted as a "fast" response (ANSI 1988). Slowly varying or steady sounds are generally measured over a period of one full second, which is denoted as a "slow" response. L_{max} is important in judging the interference caused by a noise event to conversation, TV or radio listening, sleep, or other common activities. L_{max} provides one measure of the intrusiveness of a noise event, but cannot provide a full description because L_{max} does include the full length of exposure to the sound.

B.2.2 Peak Sound Pressure Level

L_{pk} is the highest instantaneous level obtained by a sound level measurement device. L_{pk} is typically measured using a 20 microseconds or faster sampling rate, and is typically based on an unweighted or linear response of the meter.

B.2.3 Sound Exposure Level

SEL is a composite metric that represents both the intensity of a sound and its duration. Individual, time-varying noise events like aircraft overflights have two main characteristics: a sound level that changes throughout the event and a period of time during which the event is heard. SEL provides a measure of the net impact of the entire acoustic event, but it does not directly represent the sound level heard at any given time. During an aircraft flyover, SEL would include both L_{max} and the lower noise levels experienced during the onset and recess periods of the overflight.

SEL is a logarithmic measure of the total acoustic energy transmitted to the listener during the noise event. Mathematically, SEL represents the sound level of a constant sound that would, in one second, generate the same acoustic energy as the actual time-varying noise event. For sound from aircraft overflights, SEL is usually greater than L_{max} because the overflight may take multiple seconds, but L_{max} only accounts for an instantaneous moment of the noise event. SEL represents the best metric to compare noise levels from individual aircraft overflights.

B.2.4 Equivalent Sound Level

L_{eq} is the continuous sound level that would be present if all variations in sound level over a specified time period were averaged on an energy basis. This average gives the same total sound energy to all the variations within the noise event.

L_{eq} has been established as a good measure of the impact of a series of noise events during a given time period. Although L_{eq} is defined as an average, it is an effective measure of the cumulative impact of noise because it represents the total noise experienced over a given period of time. For example, the average of all noise-generating events during the period of 7 a.m. to 4 p.m. could be used to provide the relative impact of noise-generating events for a school day.

B.2.5 Day-Night Average Sound Level and Community Noise Equivalent Level (CNEL)

DNL and CNEL are composite metrics that account for all noise events in a 24-hour period. In order to account for increased human sensitivity to noise at night, a 10 dB penalty is applied to nighttime noise events (10 p.m. to 7 a.m. time period). CNEL includes a 5 dB penalty for noise that occurs between 7 p.m. and 10 p.m. along with the 10 dB penalty for nighttime noise events.

Like L_{eq}, DNL and CNEL without their penalties are average quantities, mathematically representing the continuous sound level that would be present if all of the variations in sound level that occur over a 24-hour period were averaged to have same total sound energy. These composite single-measure time-average metrics account for the SELs, L_{max}, the duration of the events (sorties or operations), and the number of events that occur over a 24-hour period; however, they do not provide specific information on the number of noise events or the individual sound levels that occur during the 24-hour day. Like SEL, neither DNL nor CNEL represent the sound level heard at any particular time, but quantify the total sound energy received. While it is normalized as an average, it represents all of the sound energy, and is therefore a cumulative measure.

The nighttime penalties for DNL and CNEL account for the added intrusiveness of sounds that occur during normal sleeping hours. This is because of the increased sensitivity to noise during those hours and because ambient sound levels during nighttime are typically about 10 dB lower than during daytime hours. The evening penalty for CNEL accounts for the added intrusiveness of sounds during that period.

Although DNL and CNEL are usually computed for 24-hour periods, they can also be calculated to encompass multiple days. For application to civil airports, where operations are consistent from day to day, DNL and CNEL are usually applied as an annual average.

The logarithmic nature of the dB can cause the noise levels of the loudest events to control the 24-hour average. Therefore, a DNL of 65 dB could result from a very few noisy events or a large number of quieter events.

As a simple example of this characteristic, consider a case in which only one aircraft overflight occurs during the daytime over a 24-hour period, creating a sound level of 100 dB for 30 seconds. During the remaining 23 hours, 59 minutes, and 30 seconds of the day, the ambient sound level is 50 dB. The DNL for this 24-hour period is 65.9 dB. Now assume that 10 such 30-second overflights occur during daytime hours during the next 24-hour period, with the same ambient sound level of 50 dB during the remaining 23 hours and 55 minutes of the day. The DNL for this 24-hour period is 75.5 dB. Thus, the averaging of noise over a 24-hour period does not ignore the louder single events, but instead tends to emphasize both the sound level and number of those events.

Daily average sound levels are typically used for the evaluation of community noise effects (i.e., long-term annoyance), and particularly aircraft noise effects. In general, scientific studies and social surveys have found a high correlation between the percentages of the number of people highly annoyed and the level of average noise exposure measured in DNL (USEPA 1978 and Schultz 1978).

B.2.6 Onset-Rate Adjusted Monthly Day-Night Average Sound Level (L_{dnmr})

Military aircraft utilizing Special Use Airspace (SUA) such as Military Training Routes (MTRs), Military Operations Areas (MOAs), and Restricted Areas/Ranges generate a noise environment that is somewhat different from that associated with airfield operations. As opposed to patterned or continuous noise environments associated with airfields, flight activity in SUAs is highly sporadic and often seasonal, ranging from ten per hour to less than one per week. Individual military overflight events also differ from typical community noise events because noise from a low-altitude, high airspeed flyover can have a rather sudden onset, exhibiting a rate of increase in sound level (onset rate) of up to 150 dB per second.

To represent these differences, the conventional SEL metric is adjusted to account for the “surprise” effect of the sudden onset of aircraft noise on humans with an adjustment that ranges from 0 to 11 dB above the normal SEL (Stusnick, *et al*. 1992). Onset rates between 15 and 150 dB per second require an adjustment of 0 to 11 dB, while onset rates below 15 dB per second require no adjustment. The adjusted SEL is designated as the onset-rate adjusted SEL (SEL_r).

In order to account for the sporadic characteristic of SUA activity and to not dilute the resultant noise exposure, the month with the most operations or sorties from a yearly tabulation (the busiest month) for the given SUA is examined. The cumulative exposure to noise in these areas is computed by DNL over the busy month using SEL_r instead of SEL. This monthly average is denoted L_{dnmr}. If onset rate adjusted DNL is computed over a period other than a month, it would be designated L_{dnr} and the period must be specified.

B.2.7 Number-of-Events Above a Threshold Level (NAL)

The NA metric provides the total number of noise events that exceed the selected noise level threshold during a specified period of time. Combined with the selected L, the NA metric is symbolized as NAL.

L can be defined in terms of either the SEL or L_{max} metric, and it is important that this selection is reflected in the nomenclature. NA can be portrayed for single or multiple locations, or it can be portrayed by means of noise contours on a map similar to DNL contours. A threshold level is selected that best meets the need for that situation, as no formal threshold of significance has been adopted by Federal agencies. Typically, an L_{max} threshold is selected to analyze speech interference, whereas an SEL threshold is selected for analysis of sleep disturbance.

B.2.8 Time Above a Specified Level (TAL)

The TA metric is a measure of the total time that the A-weighted aircraft noise level is at or above a defined sound level threshold. Combined with the selected L, the TA metric is symbolized as TAL. TA is not a sound level, but rather a time expressed in minutes. TA values can be calculated over a full 24-hour annual average day, the 15-hour daytime and 9-hour nighttime periods, a school day, or any other time period of interest, provided there is operational data to define the time period of interest.

TA can be applied to describe the noise environment in schools, particularly when comparing the effects on a classroom, or other noise sensitive environments, for different operational scenarios. TA can be portrayed by means of noise contours on a map similar to DNL contours.

The TA metric is a useful descriptor of the noise impact of an individual event or for many events occurring over a certain time period. When computed for a full day, the TA can be compared to the DNL in order to determine the sound levels and total duration of events that contributed to the DNL. TA analysis is usually conducted along with NA analysis so that the results will show not only how many events occur above the selected threshold(s), but also the total duration of those events above those levels for the selected time period.

B.3 NOISE EFFECTS

This noise effects section includes discussions of annoyance, speech interference and sleep disturbance, and the effects of noise on hearing, health, performance, learning, animals, property values, terrain, and archaeological sites.

B.3.1 Annoyance

The primary effect of aircraft noise on exposed communities is long-term annoyance, defined by the U.S. Environmental Protection Agency (USEPA) as any negative subjective reaction on the part of an individual or group. The scientific community has adopted the use of long-term annoyance as a primary indicator of community response because it attempts to account for all negative aspects of effects from noise. These include increased annoyance due to being awakened at night by aircraft and interference with everyday conversation.

Numerous laboratory studies and field surveys have been conducted to measure annoyance. These studies account for a number of variables, many of which are dependent on a person's individual circumstances and preferences. Laboratory studies of individual responses to noise have helped isolate a number of the factors contributing to annoyance, such as the intensity level and spectral characteristics of the noise, the duration, the presence of impulses, the pitch, the information content, and the degree of interference with activity. Social surveys of community response to noise have allowed the development of general dose-response relationships that can be used to estimate the proportion of people who will be highly annoyed by a given noise level. The results of these studies have formed the basis for criteria established to define areas of compatible land use.

A wide variety of responses have been used to determine the intrusiveness of noise and disturbances of speech, sleep, audio/video entertainment, and outdoor living, but the most useful metric for assessing peoples' responses to noise is the percentage of the population expected to be "highly annoyed." The concept of "percent highly annoyed" has provided the most consistent response of a community to a particular noise environment. In a synthesis of several different social surveys that employed different response scales, Schultz defined "highly annoyed" respondents as those respondents whose self-described annoyance fell within the upper 28 percent of the response scale, where the scale was numerical or unnamed (1978). For surveys where the response scale was named, Schultz counted those who claimed to be highly annoyed by combining the responses of "very annoyed" and "extremely annoyed." Schultz's definition of "percent highly annoyed" (%HA) became the basis for the Federal policy on environmental noise. Daily average sound levels are typically used for the evaluation of community noise effects, such as long-term annoyance.

In general, scientific studies and social surveys have found a correlation between the percentages of groups of people highly annoyed and the level of average noise exposure. Thus, the results are expressed as the average %HA at various exposure levels measured in DNL. The classic analysis is Schultz's original 1978 study, shown in Figure B-3. This figure is commonly referred to as the Schultz curve. It represents the synthesis of a large number of social surveys (161 data points in all) that relate the long-term community response to various types of noise sources, measured using the DNL metric.

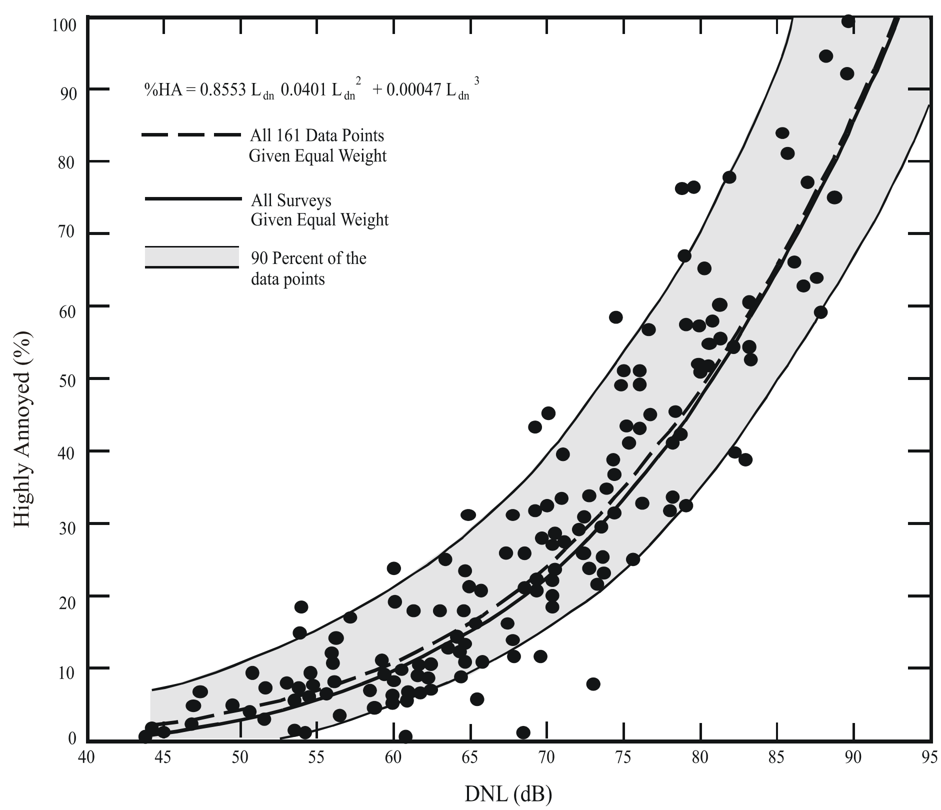
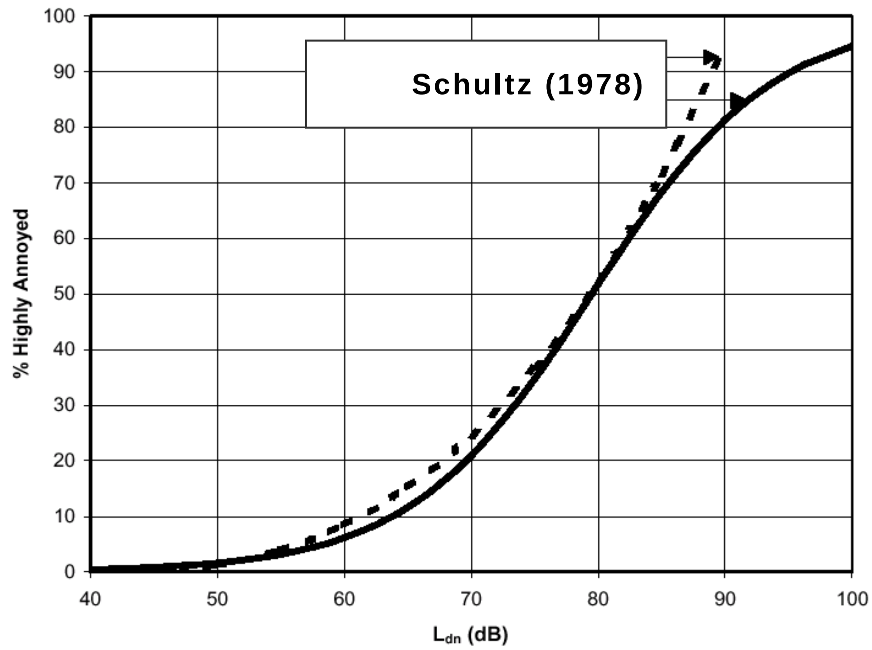


Figure B-3

An updated study of the original Schultz data, based on the analysis of 400 data points collected through 1989, essentially reaffirmed this relationship. Figure B-4 shows an updated form of the alongside the original Schultz curve (Finegold 1994). The updated fit, which does not differ substantially from the original, is the preferred form in the U.S. The relationship between %HA and DNL is:

$$\%HA = 100/[1+ \exp(11.13 - 0.141L_{dn})]$$



Source: Schultz, 1978, and Finegold, *et al.* 1994, Curve Fits.

Figure B-4

In general, correlation coefficients of 0.85 to 0.95 are found between the percentages of groups of people highly annoyed and the level of average noise exposure. However, the correlation coefficients for the annoyance of individuals are relatively low, on the order of 0.5 or less. This is caused by the varying personal factors that influence the manner in which individuals react to noise.

A number of non-acoustic factors have been identified that may influence the annoyance response of an individual. Newman and Beattie divided these factors into emotional and physical variables (1985).

Emotional Variables include:

- Feelings about the necessity or preventability of the noise;
- Judgment of the importance and value of the activity that is producing the noise;
- Activity at the time an individual hears the noise;
- Attitude about the environment;
- General sensitivity to noise;
- Beliefs about the effect of noise on health; and
- Feelings of fear associated with the noise.

Physical Variables:

- Type of neighborhood;

- Time of day;
- Season;
- Predictability of noise;
- Control over the noise source; and
- Length of time an individual is exposed to a noise.

The low correlation coefficients for individuals' reactions reflect the large amount of scatter among the data drawn from the various surveys, and point to the substantial uncertainty associated with the equation representing the relationship between %HA and DNL. Based on the results of surveys, it has been observed that noise exposure can explain less than 50 percent of the observed variance in annoyance, indicating that non-acoustical factors play a major role. As a result, it is not possible to accurately predict individual annoyance in any specific community based on the aircraft noise exposure. Nevertheless, changes in %HA can be useful in giving the decision maker more information about the relative effects that different alternatives may have on the community.

The original Schultz curve and the subsequent updates do not separate out the annoyance from aircraft noise and other transportation noise sources. This was an important element because it allowed Schultz to obtain some consensus among the various social surveys from the 1960s and 1970s that were synthesized in the analysis. In essence, the Schultz curve assumes that the effects of long-term annoyance on the general population are the same, regardless of whether the noise source is road, rail, or aircraft. In the years after the Schultz analysis, additional social surveys have been conducted to better understand the annoyance effects of various transportation sources.

Miedema and Vos present synthesis curves for the relationship between DNL and the percentage of people "Annoyed" versus the percentage "Highly Annoyed" for three transportation noise sources (1998). Separate, nonidentical curves were found for aircraft, road traffic, and railway noise. Table B-1 illustrates that, for a DNL of 65 dB, the percentage of people forecasted to be highly annoyed is 28 percent for air traffic, 18 percent for road traffic, and 11 percent for railroad traffic. For an outdoor DNL of 55 dB, the percentage of people highly annoyed would be close to 12 percent if the noise is generated by aircraft operations, but only 7 percent and 4 percent for road and rail traffic, respectively. Comparing the levels on the Miedema and Vos curve to those on the updated Schultz curve indicates that the percentage of people highly annoyed by aircraft noise may be higher than previously anticipated when the noise is solely generated by aircraft activity.

Table B-1

DNL (dB)	Percent Hightly Annoyed (%HA)			
	Miedema and Vos			Schultz Combined
	Air	Road	Rail	
55	12	7	4	3
60	19	12	7	6
65	28	18	11	12
70	37	29	16	22
75	48	40	22	36

Source: Miedema & Vos 1998.

As noted by the World Health Organization (WHO), even though aircraft noise seems to produce a stronger annoyance response than road traffic, caution should be exercised when interpreting synthesized data from different studies (WHO 2000). The WHO noted that five major parameters should be randomly distributed for the analyses to be valid: personal, demographic, and lifestyle factors, as well as the duration of noise exposure and the population experience with noise.

The Federal Interagency Committee on Noise (FICON) found that the updated Schultz curve remains the best available source to predict community response to transportation noise without any segregation by transportation source (FICON 1992); a position also held by the Federal Interagency Committee on Aircraft Noise (FICAN) in 1997 (FICAN 1997). However, FICON also recommended further research to investigate the differences in perceptions of aircraft noise, ground transportation noise (highways and railroads), and general background noise.

B.3.2 Speech Interference

Speech interference associated with aircraft noise is a primary cause of annoyance for communities. The disruption of routine activities such as radio or television listening, telephone use, or family conversation gives rise to frustration and irritation. The quality of speech communication is particularly important in classrooms and offices. In industrial settings it can cause fatigue and vocal strain in those who attempt to communicate over the noise.

The disruption of speech in the classroom is a primary concern, due to the potential for adverse effects on a child's learning ability. There are two aspects to speech comprehension:

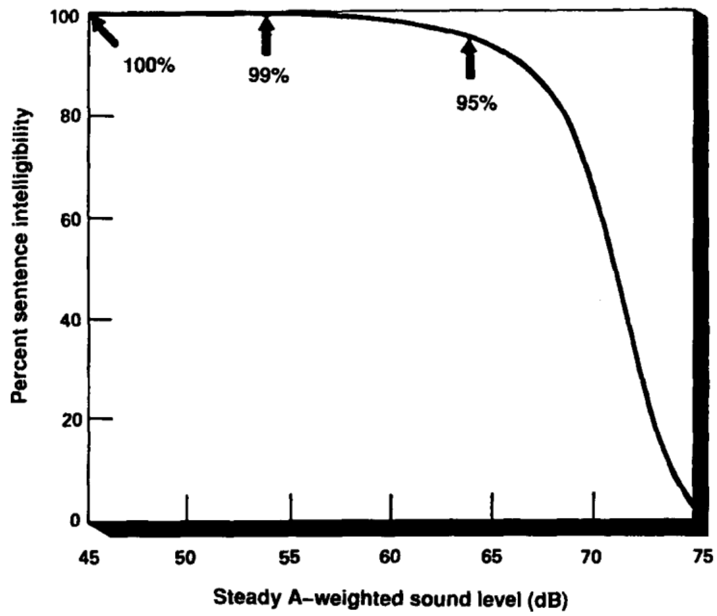
1. *Word Intelligibility* - the percent of words transmitted and received. This might be important for students in the lower grades who are learning the English language, and particularly for students who are learning English as a Second Language.
2. S*entence Intelligibility* – the percent of sentences transmitted and understood. This might be important for high-school students and adults who are familiar with the language, and who do not necessarily have to understand each word in order to understand sentences.

For teachers to be clearly understood by their students, it is important that regular voice communication is clear and uninterrupted. Not only does the background sound level have to be low enough for the teacher to be clearly heard, but intermittent outdoor noise events also need to be minimized. It is therefore important to evaluate the steady background level, the level of voice communication, and the single-event level due to aircraft overflights that might interfere with speech.

Several research studies have been conducted and guideline documents have been developed that result in a fairly consistent set of noise level criteria for speech interference. This section provides an overview of the results of these studies.

B.3.2.1 U.S. Federal Criteria for Interior Noise

In 1974, the USEPA identified a goal of an indoor 24-hour average sound level $L_{eq(24)}$ of 45 dB to minimize speech interference, based on the intelligibility of sentences in the presence of a steady background noise (USEPA 1974). Intelligibility pertains to the percentage of speech units correctly understood out of those transmitted, and specifies the type of speech material used, i.e., sentences or words. The curve displayed in Figure B-5 shows the effect of steady indoor background sound levels on sentence intelligibility. For an average adult with normal hearing and fluency in the language, steady indoor background sound levels of less than 45 dB L_{eq} are expected to allow 100 percent intelligibility of sentences.



Source: USEPA 1974.

Figure B-5

The curve shows 99 percent sentence intelligibility for background sound levels at an L_{eq} of 54 dB, and less than 10 percent intelligibility for background levels above an L_{eq} of 73 dB. Note that the curve is especially sensitive to changes in sound level between 65 dB and 75 dB. An increase of 1 dB in background sound level from 70 dB to 71 dB results in a 14 percent decrease in sentence intelligibility, whereas a 1 dB increase in background sound level from 60 dB to 61 dB results in a less than 1 percent decrease in sentence intelligibility.

B.3.2.2 Classroom Criteria

For listeners with normal hearing and fluency in the language, complete sentence intelligibility can be achieved when the signal-to-noise ratio (i.e., the difference between the speech level and the level of the interfering noise) is in the range 15 to 18 dB (Lazarus 1990).

Both the ANSI and the American Speech-Language-Hearing Association (ASHLA) recommend at least a 15 dB signal-to-noise ratio in classrooms to ensure that children with hearing impairments and language disabilities are able to enjoy high speech intelligibility (ANSI 2002; ASHLA 1995). As such, provided that the average adult male or female voice registers a minimum of 50 dB L_{max} in the rear of the classroom, the ANSI standard requires that the continuous background noise level indoors must not exceed an L_{eq} of 35 dB (assumed to apply for the duration of school hours).

The WHO reported that for a speaker-to-listener distance of about 1 meter, empirical observations have shown that speech in relaxed conversations is 100 percent intelligible in background noise levels of about 35 dB, and speech can be fairly well understood in the presence of background levels of 45 dB. The WHO recommends a guideline value of 35 dB L_{eq} for continuous background levels in classrooms during school hours (WHO 2000).

Bradley suggests that in smaller rooms, where speech levels in the rear of the classroom are approximately 50 dB L_{max}, steady-state noise levels above 35 dB L_{eq} may interfere with the intelligibility of speech (1993).

For the purposes of determining eligibility for noise insulation funding, the Federal Aviation Administration (FAA) guidelines state that the design objective for a classroom environment is 45 dB L_{eq} resulting from aircraft operations during normal school hours (FAA 1985).

However, most aircraft noise is not continuous and consists of individual events where the sound level exceeds the background level for a limited time period as the aircraft flies over. Since speech interference in the presence of aircraft noise is essentially determined by the magnitude and frequency of individual aircraft flyover events, a time-averaged metric alone, such as L_{eq}, is not necessarily appropriate when evaluating the overall effects. In addition to the background level criteria described above, single-event criteria, which account for those sporadic, intermittent outdoor noisy events, are also essential when specifying speech interference criteria.

In 1984, a report to the Port Authority of New York and New Jersey recommended utilizing the Speech Interference Level (SIL) metric for classroom noise criteria (Sharp and Plotkin 1984). This metric is based on the maximum sound levels in the frequency range (approximately 500 Hz to 2,000 Hz) that directly affect speech communication. The study identified an SIL (the average of the sound levels in the 500, 1000, and 2000 Hz octave-bands) of 45 dB as the desirable goal, which was estimated to provide 90 percent word intelligibility for the short time periods during aircraft over-flights. Although early classroom level criteria were defined in terms of SIL, the use and measurement of L_{max} as the primary metric has since become more popular. Both metrics take into consideration the L_{max} associated with intermittent noise events and can be related to existing background levels when determining speech interference percentages. An SIL of 45 dB is approximately equivalent to an A-weighted L_{max} of 50 dB for aircraft noise (Wesler 1986).

In 1998, a report also concluded that if an aircraft noise event's indoor L_{max} reached the speech level of 50 dB, 90 percent of the words would be understood by students seated throughout the classroom (Lind, Pearsons, and Fidell 1998). Intermittent aircraft noise does not appreciably disrupt classroom communication at lower levels or continuously, so the authors adopted an indoor L_{max} of 50 dB as the maximum single-event level permissible in classrooms. Note that this limit was set based on students with normal hearing and no special needs; at-risk students may be adversely affected at lower sound levels.

Bradley suggests that SEL is a better indicator of indoor estimated speech interference in the presence of aircraft overflights (1985). For acceptable speech communication using normal vocal efforts, Bradley suggests that the indoor SEL be no greater than 64 dB. The author assumes a 26 dB outdoor-to- indoor noise reduction that equates to 90 dB SEL outdoors. Therefore, aircraft events producing outdoor SEL values greater than 90 dB would result in disruption to indoor speech communication. Bradley's work indicates that, for speakers talking with a casual vocal effort, 95 percent intelligibility would be achieved when indoor SEL values do not exceed 60 dB, which translates approximately to an L_{max} of 50 dB.

In the presence of intermittent noise events, ANSI states that the criteria for allowable background noise level can be relaxed since speech is impaired only for the short time when the aircraft noise is close to its maximum value. Consequently, ANSI recommends that when the background noise level of the noisiest hour is dominated by aircraft noise, the indoor criteria (35 dB L_{eq} for continuous background noise) can be increased by 5 dB to an L_{eq} of 40 dB, as long as the noise level does not exceed 40 dB for more than 10 percent of the noisiest hour (ANSI 2002).

The WHO does not recommend a specific indoor L_{max} criterion for single-event noise, but does place a guideline value at an L_{eq} of 35 dB for overall background noise in the classroom. However, WHO does report that "for communication distances beyond a few meters, speech interference starts at sound pressure levels below 50 dB for octave bands centered on the main speech frequencies at 500 Hz, [1000 Hz], and [2000 Hz]" (WHO 2000). It can be inferred that this can be approximated by an L_{max} value of 50 dB.

The United Kingdom Department for Education and Skills (UKDFES) established, in its classroom acoustics guide, a 30-minute time-averaged metric ($L_{eq\ [30min]}$) for background levels and $L_{A1,30}$ min for intermittent noises, at thresholds of 30 to 35 dB and 55 dB, respectively. $L_{A1,30}$ min represents the A-weighted sound level that is exceeded one percent of the time (in this case, during a 30 minute teaching session) and is generally equivalent to the L_{max} metric (UKDFES 2003).

B.3.2.3 Summary

As the previous section demonstrates, research indicates that it is not only important to consider the continuous background levels using time-averaged metrics, but also the intermittent events, using single-event metrics such as L_{max}. Table B-2 provides a summary of the noise level criteria recommended in the scientific literature.

Table B-2

Source	Metric/Level (dB)	Effects and Notes
U.S. FAA (1985)	L_{eq}(during school hours) = 45 dB	Federal assistance criteria for school sound insulation; supplemental single-event criteria may be used
Lind et al. (1998) Sharp and Plotkin (1984) Wesler (1986)	L_{max} = 50 dB / SIL 45	Single event level permissible in the classroom
WHO (1999)	L_{eq} = 35 dB L_{max} = 50 dB	Assumes average speech level of 50 dB and recommends signal to noise ratio of 15 dB
U.S. ANSI (2002)	L_{eq} = 40 dB, Based on Room Volume	Acceptable background level for continuous noise/ relaxed criteria for intermittent noise in the classroom
U.K. DFES (2003)	$L_{eq(30min)}$ = 30-35 dB L_{max} = 55 dB	Minimum acceptable in classroom and most other learning environs

When considering intermittent noise caused by aircraft overflights, a review of the relevant scientific literature and international guidelines indicates that an appropriate criterion is a limit on indoor background noise levels of 35 to 40 dB L_{eq} and a limit on single events of 50 dB L_{max}.

B.3.3 Sleep Disturbance

The disturbance of sleep is a major concern for communities exposed to nighttime aircraft noise. There have been numerous research studies that have attempted to quantify the complex effects of noise on sleep. This section provides an overview of the major noise-induced sleep disturbance studies that have been conducted, with particular emphasis placed on those studies that have influenced U.S. Federal noise policy. The studies have been separated into two groups:

1. Initial studies that were performed in the 1960s and 1970s, where the research was focused on laboratory sleep observations.
2. Later studies that were performed from the 1990s to the present, where the research was focused on field observations and the correlations previous to laboratory research.

B.3.3.1 Initial Studies

The relationship between noise levels and sleep disturbance is complex and not fully understood. The disturbance depends not only on the depth of sleep, but also on the previous exposure to aircraft noise, familiarity with the surroundings, the physiological and psychological condition of the recipient, and a host of other situational factors. The most readily measurable effect of noise on sleep is the number of arousals or awakenings, so the body of scientific literature has focused on predicting the percentage of the population that will be awakened at various noise levels. Fundamentally, regardless of the tools used to measure the degree of sleep disturbance (awakenings, arousals, etc.), these studies have grouped the data points into bins to predict the percentage of the population likely to be disturbed at various sound level thresholds.

FICON produced a guidance document that provided an overview of the most pertinent sleep disturbance research that had been conducted throughout the 1970s (FICON 1992). Literature reviews and meta-analysis conducted between 1978 and 1989 made use of the existing datasets that indicated the effects of nighttime noise on various sleep-state changes and awakenings (Lukas 1978; Griefahn 1978; Peasons et al. 1989). FICON noted that various indoor A-weighted sound levels – ranging from 25 to 50 dB were observed to be thresholds below which significant sleep effects were not expected. FICON did not endorse the reliability of the results due to the large variability in the data.

However, FICON did recommend the use of an interim dose-response curve—awaiting future research—that predicted the percent of the exposed population expected to be awakened as a function of the exposure to single event noise levels, which were expressed in terms of SEL. This curve was based on the research conducted for the U.S. Air Force (Finegold 1994). The dataset included most of the research performed up to that point, and predicted that ten percent of the population would be awakened when exposed to an interior SEL of approximately 58 dB. The data utilized to derive this relationship were primarily the results of controlled laboratory studies.

B.3.3.2 Recent Sleep Disturbance Research – Field and Laboratory Studies

It was noted in the early sleep disturbance research that the controlled laboratory studies did not account for many factors that are important to sleep behavior, such as habituation to the environment, previous exposure to noise, and awakenings from sources other than aircraft noise. In the early 1990s, field studies were conducted to validate the earlier laboratory work. The most significant finding from these studies was that an estimated 80 to 90 percent of sleep disturbances were not related to individual outdoor noise events, but were instead the result of indoor noise sources and other non-noise-related factors. The results showed that there was less of an effect of noise on sleep in real-life conditions than had been previously reported from laboratory studies.

B.3.3.3 FICAN

The interim FICON dose-response curve that was recommended for use in 1992 was based on the most pertinent sleep disturbance research that was conducted through the 1970s, primarily in laboratory settings. After that time, considerable field research was conducted to evaluate the sleep effects in peoples' normal, home environment. Laboratory sleep studies tend to show higher values of sleep disturbance than field studies because people who sleep in their own homes are habituated to their environment and, therefore, do not wake up as easily (FICAN 1997).

Based on the new information, FICAN updated its recommended dose-response curve in 1997, depicted as the lower curve in Figure B-6. This figure is based on the results of three field studies (Ollerhead 1992; Fidell et al. 1994; Fidell et al. 1995a and 1995b), along with the datasets from six previous field studies.

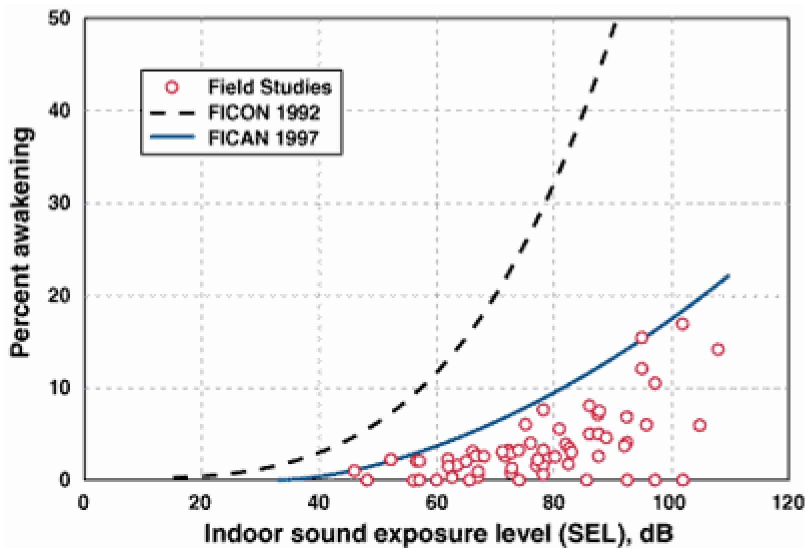


Figure B-6

The new relationship represents the higher end, or upper envelope, of the latest field data. It should be interpreted as predicting the "maximum percent of the exposed population expected to be behaviorally awakened" or the "maximum percent awakened" for a given residential population. According to this relationship, a maximum of 3 percent of people would be awakened at an indoor SEL of 58 dB, compared to 10 percent using the 1992 curve. An indoor SEL of 58 dB is equivalent to outdoor SEL's of 73 and 83 dB respectively assuming 15 and 25 dB noise level reduction from outdoor to indoor with windows open and closed, respectively.

The FICAN 1997 curve is represented by the following equation:

Percent Awakenings = 0.0087 x [SEL–30]1.79

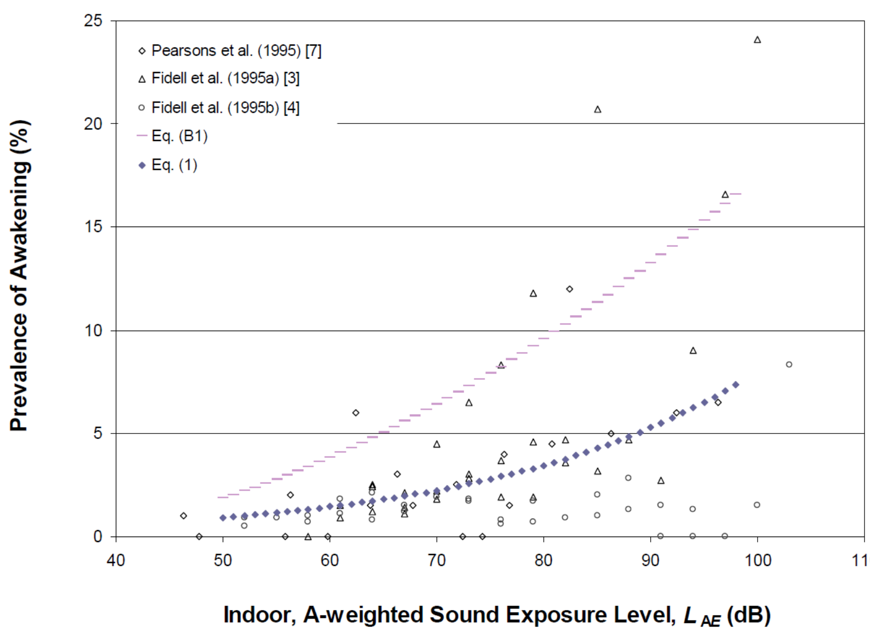
Note the relatively low percentage of awakenings to fairly high noise levels. People think they are awakened by a noise event, but usually the reason for awakening is otherwise. For example, the 1992 UK CAA study found that the average person was awakened about 18 times per night for reasons other than exposure to an aircraft noise. Some of these awakenings are due to the biological rhythms of sleep and some to other reasons that were not correlated with specific aircraft events.

B.3.3.4 Number of Events and Awakenings

In recent years, there have been studies and one proposal that attempted to determine the effect of multiple aircraft events on the number of awakenings. The German Aerospace Center (DLR) conducted an extensive study focused on the effects of nighttime aircraft noise on sleep and other related human performance factors (Basner 2004). The DLR study was one of the largest studies to examine the link between aircraft noise and sleep disturbance and involved both laboratory and in home field research phases. The DLR investigators developed a dose-effect curve that predicts the number of aircraft events at various values of Lmax expected to produce one additional awakening over the course of a night. The dose-effect curve was based on the relationships found in the field studies.

In July 2008 ANSI and the Acoustical Society of America (ASA) published a method to estimate the percent of the exposed population that might be awakened by multiple aircraft noise events based on statistical assumptions about the probability of awakening (or not awakening) (ANSI 2008). This method relies on probability theory rather than direct field research/experimental data to account for multiple events.

Figure B-7 depicts the awakenings data that form the basis and equations of ANSI S12.9-2008. The curve labeled 'Eq. (B1)' is the relationship between noise and awakening endorsed by FICAN in 1997. The ANSI recommended curve labeled 'Eq. (1)' quantifies the probability of awakening for a population of sleepers, who are exposed to an outdoor noise event as a function of the associated indoor SEL in the bedroom. This curve was derived from studies of behavioral awakenings associated with noise events in "steady state" situations where the population has been exposed to the noise long enough to be habituated. The data points in Figure B-7 come from these studies. Unlike the FICAN curve, the ANSI 2008 curve represents the average of the field research data points.



Source: ANSI 2008.

Figure B-7

In December 2008, FICAN recommended the use of this new estimation procedure for future analyses of behavioral awakenings from aircraft noise. In that statement, FICAN also recognized that additional sleep disturbance research is underway by various research organizations, and results of that work may result in additional changes to FICAN's position. Until that time, FICAN recommends the use of ANSI S12.9-2008.

B.3.4 Noise-Induced Hearing Impairment

Residents in surrounding communities express concerns regarding the effects of aircraft noise on hearing. This section provides a brief overview of hearing loss caused by noise exposure. The goal is to provide a sense of perspective as to how aircraft noise (as experienced on the ground) compares to other activities that are often linked with hearing loss.

B.3.4.1 Hearing Threshold Shifts

Hearing loss is generally interpreted as a decrease in the ear's sensitivity or acuity to perceive sound, i.e., a shift in the hearing threshold to a higher level. This change can either be a Temporary Threshold Shift (TTS) or a Permanent Threshold Shift (PTS) (Berger 1995).

TTS can result from exposure to loud noise over a given amount of time, yet the hearing loss is not necessarily permanent. An example of TTS is a person attending a loud music concert. After the concert is over, the person may experience a threshold shift that may last several hours, depending upon the level and duration of exposure. While experiencing TTS, the person becomes less sensitive to low-level sounds, particularly at certain frequencies in the speech range (typically near 4,000 Hz). Normal hearing ability eventually returns as long as the person has enough time to recover within a relatively quiet environment.

PTS usually results from repeated exposure to high noise levels, where the ears are not given adequate time to recover from the strain and fatigue of exposure. A common example of PTS is comes from working in a loud environment such as a factory. It is important to note that a TTS can eventually become PTS over time with continuous exposure to high noise levels. Thus, even if the ear is given time to recover from TTS, repeated occurrence of TTS may eventually lead to permanent hearing loss. The point at which TTS results in PTS is difficult to identify and varies with a person's sensitivity.

B.3.4.2 Criteria for Permanent Hearing Loss

Considerable data on hearing loss have been collected and analyzed by the scientific/medical community. It is well established that continuous exposure to high noise levels will damage human hearing (USEPA 1978). The Occupational Safety and Health Administration (OSHA) regulation of 1971 standardizes the limits on workplace noise exposure for protection from hearing loss. The regulation sets an average level of 90 dB over an 8-hour work period or 85 dB over a 16-hour period, with the average level based on a 5 dB decrease per doubling of exposure time (US Department of Labor 1970). Even the most protective criterion (no measurable hearing loss for the most sensitive portion of the population at the ear's most sensitive frequency, 4,000 Hz, after a 40-year exposure) is an average sound level of 70 dB over a 24-hour period.

The USEPA established 75 dB for an 8-hour exposure and 70 dB for a 24-hour exposure as the average noise level standard required to protect 96 percent of the population from greater than a 5 dB PTS (USEPA 1978). The National Academy of Sciences Committee on Hearing, Bioacoustics, and

Biomechanics identified 75 dB as the minimum level at which hearing loss may occur (CHABA 1977). Finally, the WHO has concluded that environmental and leisure-time noise below an L_{eq24} value of 70 dB "will not cause hearing loss in the large majority of the population, even after a lifetime of exposure" (WHO 2000).

B.3.4.3 Hearing Loss and Aircraft Noise

The 1982 USEPA Guidelines report specifically addresses the criteria and procedures for assessing noise-induced hearing loss in terms of the Noise-Induced Permanent Threshold Shift (NIPTS). NIPTS is a quantity that defines the permanent change in hearing level, or threshold, caused by exposure to noise (USEPA 1982). Numerically, the NIPTS is the change in threshold averaged over the frequencies 500, 1,000, 2,000, and 4,000 Hz that can be expected from daily exposure to noise over a normal working lifetime of 40 years, with the exposure beginning at an age of 20 years old. A grand average of the NIPTS over time (40 years) and hearing sensitivity (10 to 90 percentiles of the exposed population) is termed the Average NIPTS, or Ave NIPTS for short. The Ave NIPTS that can be expected for noise exposure as measured by the DNL metric is given in Table B-3.

Table B-3

DNL	Ave. NIPTS dB*	10th Percentile NIPTS dB*
75-76	1.0	4.0
76-77	1.0	4.5
77-78	1.6	5.0
78-79	2.0	5.5
79-80	2.5	6.0
80-81	3.0	7.0
81-82	3.5	8.0
82-83	4.0	9.0
83-84	4.5	10.0
84-85	5.5	11.0
85-86	6.0	12.0
86-87	7.0	13.5
87-88	7.5	15.0
88-89	8.5	16.5
89-90	9.5	18.0

* Rounded to the nearest 0.5 dB

For example, for a noise exposure of 80 dB DNL, the expected lifetime average value of NIPTS is 2.5 dB, or 6.0 dB for the 10^{th} percentile. Characterizing the noise exposure in terms of DNL will usually overestimate the assessment of hearing loss risk because DNL includes a 10 dB weighting factor for aircraft operations occurring between 10 p.m. and 7 a.m. If, however, flight operations between the hours of 10 p.m. and 7 a.m. account for 5 percent or less of the total 24-hour operations, the overestimation is on the order of 1.5 dB.

From a civilian airport perspective, the scientific community has concluded that there is little likelihood that the resulting noise exposure from aircraft noise could result in either temporary or permanent hearing loss. Studies on community hearing loss from exposure to aircraft flyovers near airports showed that there is no danger, under normal circumstances, of hearing loss due to aircraft noise (Newman and Beattie

1985). The USEPA criterion (L_{eq24} = 70 dBA) can be exceeded in some areas located near airports, but only outdoors. Inside a building, where people are more likely to spend most of their time, the average noise level will be much less than 70 dBA (Eldred and von Gierke 1993). Eldred and von Gierke also report that "several studies in the U.S., Japan, and the U.K. have confirmed the predictions that the possibility for permanent hearing loss in communities, even under the most intense commercial take-off and landing patterns, is remote" (1993).

With regard to military airbases, as individual aircraft noise levels increase with the introduction of new aircraft, a 2009 Department of Defense (DoD) policy directive requires that hearing loss risk be estimated for the at risk population, defined as the population exposed to DNL greater than or equal to 80 dB (DoD 2009). Specifically, DoD components are directed to "use the 80 DNL noise contour to identify populations at the most risk of potential hearing loss". This does not preclude populations outside the 80 DNL contour, i.e., at lower exposure levels, from being at some degree of risk of hearing loss. However, the analysis should be restricted to populations within this contour area, including residents of on-base housing. The exposure of workers inside the base boundary area should be considered occupational and evaluated using the appropriate DoD component regulations for occupational noise exposure.

With regard to military airspace activity, studies have shown conflicting results. A 1995 laboratory study measured changes in human hearing from noise representative of low-flying aircraft on MTRs (Nixon et al. 1993). The potential effects of aircraft flying along MTRs is of particular concern because maximum overflight noise levels can exceed 115 dB, with rapid increases in noise levels exceeding 30 dB per second. In this study, participants were first subjected to four overflight noise exposures at A-weighted levels of 115 dB to 130 dB. Fifty percent of the subjects showed no change in hearing levels, 25 percent had a temporary 5 dB *increase* in sensitivity (the people could hear a 5 dB wider range of sound than before exposure), and 25 percent had a temporary 5 dB decrease in sensitivity(the people could hear a 5 dB narrower range of sound than before exposure). In the next phase, participants were subjected to a single overflight at a maximum level of 130 dB for eight successive exposures, separated by 90 seconds, or until a temporary shift in hearing was observed. The temporary hearing threshold shifts showed an *increase* in sensitivity of up to 10 dB.

In another study of 115 test subjects between 18 and 50 years old, temporary threshold shifts were measured after laboratory exposure to military low-altitude flight noise (Ising *et al.* 1999).

According to the authors, the results indicate that repeated exposure to military low-altitude flight noise with L_{max} greater than 114 dB, especially if the noise level increases rapidly, may have the potential to cause noise induced hearing loss in humans.

B.3.4.4 Summary

Aviation and typical community noise levels near airports are not comparable to the occupational or recreational noise exposures associated with hearing loss. Studies of aircraft noise levels associated with civilian airport activity have not definitively correlated permanent hearing impairment with aircraft activity. It is unlikely that airport neighbors will remain outside their homes 24 hours per day, so there is little likelihood of hearing loss below an average sound level of 75 dB DNL. Near military airbases, average noise levels above 75 dB may occur. Although new DoD policy dictates that NIPTS be evaluated, no research results to date have definitively related permanent hearing impairment to aviation noise.

B.3.5 Non-auditory Health Effects

Studies have been conducted to determine whether correlations exist between noise exposure and cardiovascular problems, birth weight, and mortality rates. The non-auditory effect of noise on humans is not as easily substantiated as the effect on hearing. The results of studies conducted in the U.S., primarily concentrating on cardiovascular response to noise, have been contradictory (Cantrell 1974). Cantrell concluded that the results of human and animal experiments show that average or intrusive noise can act as a stress-provoking stimulus. Prolonged stress is known to be a contributor to a number of health disorders. Kryter and Poza state, “it is more likely that noise-related general ill-health effects are due to the psychological annoyance from the noise interfering with normal everyday behavior, than it is from the noise eliciting, because of its intensity, reflexive response in the autonomic or other physiological systems of the body” (1980). Psychological stresses may cause a physiological stress reaction that could result in impaired health.

The National Institute for Occupational Safety and Health and the USEPA commissioned CHABA in 1981 to study whether established noise standards are adequate to protect against health disorders other than hearing defects. CHABA’s conclusion was that:

“Evidence from available research reports is suggestive, but it does not provide definitive answers to the question of health effects, other than to the auditory system, of long-term exposure to noise. It seems prudent, therefore, in the absence of adequate knowledge as to whether or not noise can produce effects upon health other than damage to auditory system, either directly or mediated through stress, that insofar as feasible, an attempt should be made to obtain more critical evidence.”

Since the CHABA report, there have been more recent studies that suggest that noise exposure may cause hypertension and other stress-related effects in adults. Near an airport in Stockholm, Sweden, the prevalence of hypertension was reportedly greater among nearby residents who were exposed to energy averaged noise levels exceeding 55 dB and maximum noise levels exceeding 72 dB, particularly older subjects and those not reporting impaired hearing ability (Rosenlund *et al*. 2001). A study of elderly volunteers who were exposed to simulated military low-altitude flight noise reported that blood pressure was raised by an L_{max} of 112 dB and high speed level increase (Michalak *et al*. 1990). Yet another study of subjects exposed to varying levels of military aircraft or road noise found no significant relationship between noise level and blood pressure (Pulles *et al*. 1990).

The U.S. Department of the Navy prepared a programmatic Environmental Assessment (EA) for the continued use of non-explosive ordnance on the Vieques Inner Range. Following the preparation of the EA, it was learned that research conducted by the University of Puerto Rico, Ponce School of Medicine, suggested that Vieques fishermen and their families were experiencing symptoms associated with vibroacoustic disease (VAD) (U.S. Department of the Navy 2002). The study alleged that exposure to noise and sound waves of large pressure amplitudes within lower frequency bands, associated with Navy training activities—specifically, air-to-ground bombing or naval fire support— was related to a larger prevalence of heart anomalies within the Vieques fishermen and their families. The Ponce School of Medicine study compared the Vieques group with a group from Ponce Playa. A 1999 study conducted on Portuguese aircraft-manufacturing workers from a single factory reported effects of jet aircraft noise exposure that involved a wide range of symptoms and disorders, including the cardiac issues on which the Ponce School of Medicine study focused. The 1999 study identified these effects as VAD.

Johns Hopkins University (JHU) conducted an independent review of the Ponce School of Medicine study, as well as the Portuguese aircraft workers study and other relevant scientific literature. JHU findings concluded that VAD should not be accepted as a syndrome, given that exhaustive research across a number of populations has not yet been conducted. JHU also pointed out that the evidence supporting the existence of VAD comes largely from one group of investigators and that similar results would have to be replicated by other investigators. In short, JHU concluded that it had not been established that noise was the causal agent for the symptoms reported, and no inference can be made as to the role of noise from naval gunfire in producing echocardiographic abnormalities (U.S. Department of the Navy 2002).

Most studies of non-auditory health effects from long-term noise exposure have found that noise exposure levels established for hearing protection will also protect against any potential non-auditory health effects, at least in workplace conditions. One of the best scientific summaries of these findings is contained in the lead paper at the National Institutes of Health Conference on Noise and Hearing Loss, held on 22 to 24 January 1990 in Washington, D.C.:

"The non-auditory effects of chronic noise exposure, when noise is suspected to act as one of the risk factors in the development of hypertension, cardiovascular disease, and other nervous disorders, have never been proven to occur as chronic manifestations at levels below these criteria (an average of 75 dBA for complete protection against hearing loss for an 8-hour day). At the 1988 International Congress on Noise as a Public Health Problem, most studies attempting to clarify such health effects did not find them at levels below the criteria protective of noise-induced hearing loss, and even above these criteria, results regarding such health effects were ambiguous. Consequently, one comes to the conclusion that establishing and enforcing exposure levels protecting against noise-induced hearing loss would not only solve the noise-induced hearing loss problem, but also any potential non-auditory health effects in the work place" (von Gierke 1990).

Although these findings were specifically directed at noise effects in the workplace, they are equally applicable to aircraft noise effects in the community environment. Research studies regarding the non-auditory health effects of aircraft noise are ambiguous, at best, and often contradictory. Yet, even those studies that purport to find such health effects use time-average noise levels of 75 dB and higher for their research.

For example, two UCLA researchers apparently found a relationship between aircraft noise levels under the approach path to Los Angeles International Airport (LAX) and increased mortality rates among the exposed residents by using an average noise exposure level greater than 75 dB for the "noise-exposed" population (Meacham and Shaw 1979). Nevertheless, three other UCLA professors analyzed those same data and found no relationship between noise exposure and mortality rates (Frerichs *et al*. 1980).

As a second example, two other UCLA researchers used this same population near LAX to show a higher rate of birth defects for 1970 to 1972 when compared with a control group residing away from the airport (Jones and Tauscher 1978). Based on this report, a separate group at the Center for Disease Control performed a more thorough study of populations near Atlanta's Hartsfield-Jackson International Airport (ATL) for 1970 to 1972 and found no relationship in their study between 17 identified categories of birth defects and aircraft noise levels above 65 dB (Edmonds *et al*. 1979).

In summary, there is no scientific basis for a claim that potential health effects exist for aircraft time average sound levels below 75 dB.

The potential for noise to affect physiological health, such as the cardiovascular system, has been speculated; however, no unequivocal evidence exists to support such claims (Harris 1997). Conclusions drawn from a review of health effect studies involving military low-altitude flight noise, with its unusually high maximum levels and rapid rise in sound level, have shown no increase in cardiovascular disease (Schwartze and Thompson 1993). Additional claims that are unsupported are that flyover noise produces increased mortality rates and increases in cardiovascular death, aggravates post-traumatic stress syndrome, increases stress, increases admissions to mental hospitals, and adversely affects pregnant women and the unborn fetus (Harris 1997).

B.3.6 Performance Effects

The effect of noise on a person's performance of activities or tasks has been the subject of many studies. Some of these studies have established links between continuous high noise levels and performance loss. Noise-induced performance losses are most frequently reported in studies employing noise levels in excess of 85 dB. Little change has been found in low-noise cases. It has been cited that moderate noise levels appear to act as a stressor for more sensitive individuals performing a difficult psychomotor task.

While the results of research on the general effect of periodic aircraft noise on performance have yet to yield definitive criteria, several general trends have been noted including:

- A periodic intermittent noise is more likely to disrupt performance than a steady-state continuous noise of the same level. Flyover noise, due to its intermittent nature, might be more likely to disrupt performance than a steady-state noise of equal level.
- Noise is more inclined to affect the quality than the quantity of work.
- Noise is more likely to impair the performance of tasks that place extreme demands on the worker.

B.3.7 Noise Effects on Children

In response to noise-specific and other environmental studies, Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks (1997), requires federal agencies to ensure that policies, programs, and activities address environmental health and safety risks to identify any disproportionate risks to children.

Research does suggest that environments with sustained high background noise can have variable effects, including effects on learning and cognitive abilities and various noise-related physiological changes.

B.3.7.1 Effects on Learning and Cognitive Abilities

The 2002 ANSI Standard (Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools, revised in 2009) refers to studies that suggest that loud and frequent background noise can affect the learning patterns of young children (ANSI 2002). The standard provides discussion on the relationships between noise and learning, and stipulates design requirements and acoustical performance criteria for outdoor-to-indoor noise isolation. School design is directed to be cognizant of, and responsive to, surrounding land uses and the shielding of outdoor noise from the indoor environment. The acoustical performance criteria for schools include the requirement that the one-hour-average background noise level shall not exceed 35 dBA in core learning spaces smaller than 20,000 cubic-feet and 40 dBA in core learning spaces with enclosed volumes exceeding 20,000 cubic-feet. This would require schools in quiet neighborhoods be constructed in a manner that lowers noise levels by 15 to 20 dBA relative to outdoor levels. In schools near airports, indoor noise levels would have to be lowered by 35 to 45 dBA relative to outdoor levels (ANSI 2002).

The studies referenced that support the new standard are not specific to jet aircraft noise and the potential effects on children. However, there are references to studies that have shown that children in noisier classrooms score lower on a variety of tests. Excessive background noise or reverberation within schools causes interferences of communication and can therefore create an acoustical barrier to learning (ANSI 2002). Previous studies contribute to the body of evidence emphasizing the importance of communication, by way of the spoken language, to the development of cognitive skills. The ability to read, write, comprehend, and maintain attentiveness, is, in part, based upon whether teacher communication is consistently intelligible (ANSI 2002).

Numerous studies have shown varying degrees of the effects of noise on the reading comprehension, attentiveness, puzzle-solving, and memory/recall ability of children. It is generally accepted that young children are more susceptible than adults to the effects of background noise. Young children are in a developmental stage (linguistic, cognitive, and proficiency), so barriers to hearing can cause interferences or disruptions in developmental evolution.

Research on the impacts of aircraft noise, and noise in general, on the cognitive abilities of school-aged children has received more attention in recent years. Several studies suggest that aircraft noise can affect the academic performance of schoolchildren. Although many factors could contribute to learning deficits in school-aged children (e.g., socioeconomic level, home environment, diet, sleep patterns), evidence exists that suggests that chronic exposure to high aircraft noise levels can impair learning.

Specifically, elementary school children attending schools near New York City's two airports demonstrated lower reading scores than children living farther away from the flight paths (Green *et al*. 1982). Researchers have found that tasks involving central processing and language comprehension (such as reading, attention, problem solving, and memory) appear to be the most affected by noise (Evans and Lepore 1993; Hygge 1994; and Evans *et al*. 1998). It has been demonstrated that chronic exposure of first- and second-grade children to aircraft noise can result in reading deficits and impaired speech perception (i.e., the ability to hear common, low-frequency [vowel] sounds but not high frequencies [consonants] in speech) (Evans and Maxwell 1997).

The Evans and Maxwell study found that chronic exposure to aircraft noise resulted in reading deficits and impaired speech perception for first- and second-grade children (1997). Other studies found that children residing near LAX had more difficulty solving cognitive problems and did not perform as well as children from quieter schools in puzzle-solving and attentiveness (Bronzaft 1997; Cohen *et al*. 1980). Children attending elementary schools in high aircraft noise areas near London's Heathrow Airport demonstrated poorer reading comprehension and selective cognitive impairments (Haines *et al*. 2001a, and 2001b). Similarly, a 1994 study found that students exposed to aircraft noise of approximately 76 dBA scored 20 percent lower on recall ability tests than students exposed to ambient noise of 42 to 44 dBA (Hygge 1994). Similar studies involving the testing of attention, memory, and reading comprehension of school children located near airports have shown that these children exhibited reduced performance results compared to those of similar groups of children who were located in quieter environments (Evans *et al*. 1998; Haines *et al*. 1998). The Haines and Stansfeld study indicated that there may be some long-term effects associated with exposure because one-year follow-up testing still demonstrated lowered scores for children in higher noise schools (Haines *et al*. 2001a, and 2001b). In contrast, a 2002 study found that although children living near the old Munich airport scored lower in standardized reading and long-term memory tests than a control group, their performance on the same tests was equal to that of the control group once the airport was closed (Hygge *et al*. 2002).

Finally, although it is recognized that there are many factors that could contribute to learning deficits in school-aged children, there is increasing awareness that chronic exposure to high aircraft noise levels may impair learning. This awareness has led the WHO and a North Atlantic Treaty Organization working group to conclude that daycare centers and schools should not be located near major sources of noise such as highways, airports, and industrial sites (WHO 2000; North Atlantic Treaty Organization 2000).

B.3.7.2 Health Effects

Physiological effects in children exposed to aircraft noise and the potential for health effects have been the focus of limited investigation. Studies include examination of blood pressure levels, hormonal secretions, and hearing loss.

As a measure of stress response to aircraft noise, authors have looked at blood pressure readings to monitor children's health. Children who were chronically exposed to aircraft noise from a new airport near Munich, Germany had modest (although significant) increases in blood pressure, significant increases in stress hormones, and a decline in quality of life (Evans *et al*. 1998). Children attending noisy schools had statistically significant higher average systolic and diastolic blood pressure ($p<0.03$). Systolic blood pressure means were 89.68 mm for children attending schools located in noisier environments compared to 86.77 mm for a control group. Similarly, diastolic blood pressure means for the noisier environment group were 47.84 mm and 45.16 for the control group (Cohen *et al*. 1980).

Although the literature appears limited, studies focused on the wide range of potential effects of aircraft noise on school children have also investigated hormonal levels of groups of children exposed to aircraft noise and compared to a control group. Specifically, two studies analyzed cortisol and urinary catecholamine levels in school children as measurements of stress response to aircraft noise (Haines *et al*. 2001b and 2001c). In both instances, there were no differences between the aircraft-noise-exposed children and the control groups.

Other studies have reported hearing losses from exposure to aircraft noise. Noise-induced hearing loss was reportedly higher in children who attended a school located under a flight path near a Taiwan airport compared to children at another school farther away (Chen *et al*. 1997). Another study reported that hearing ability was reduced significantly in individuals who lived near an airport and were frequently exposed to aircraft noise (Chen and Chen 1993). In that study, noise exposure near the airport was reportedly uniform, with DNL greater than 75 dB and maximum noise levels of about 87 dB during overflights. Conversely, several other studies that were reviewed reported no difference in hearing ability between children exposed to high levels of airport noise and children located in quieter areas (Fisch 1977; Andrus *et al*. 1975; Wu *et al*. 1995).

B.3.8 Effects on Domestic Animal and Wildlife

Hearing is critical to an animal's ability to react, compete, reproduce, hunt, forage, and survive in its environment. While the existing literature does include studies on possible effects of jet aircraft noise and sonic booms on wildlife, there appears to have been little concerted effort in developing quantitative comparisons of aircraft noise effects on normal auditory characteristics. Behavioral effects have been relatively well described, but the larger ecological context issues, and the potential for drawing conclusions regarding effects on populations, has not been well developed.

The relationships between potential auditory/physiological effects and species interactions with their environments are not well understood. Manci *et al*. assert that the consequences that physiological effects may have on behavioral patterns are vital to understanding the long-term effects of noise on wildlife (1988). Questions regarding the effects (if any) on predator-prey interactions, reproductive success, and intra-inter specific behavior patterns remain.

The following discussion provides an overview of the existing literature on noise effects (particularly jet aircraft noise) on animal species. The literature reviewed outlines those studies that have focused on the observations of the behavioral effects that jet aircraft and sonic booms have on animals.

A great deal of research was conducted in the 1960's and 1970's on the effects of aircraft noise on the public and the potential for adverse ecological impacts. These studies were largely completed in response to the increase in air travel and the introduction of supersonic jet aircraft. According to Manci et al., the foundation of information created from that focus does not necessarily correlate or provide information specific to the impacts to wildlife in areas overflown by aircraft at supersonic speed or at low altitudes (1988).

The abilities to hear sounds and noise and to communicate assist wildlife in maintaining group cohesiveness and survivorship. Social species communicate by transmitting calls of warning, introduction, and others that are subsequently related to an individual's or group's responsiveness.

Animal species differ greatly in their responses to noise. Noise effects on domestic animals and wildlife are classified as primary, secondary, and tertiary. Primary effects are direct, physiological changes to the auditory system, and most likely include the masking of auditory signals. Masking is defined as the inability of an individual to hear important environmental signals that may arise from mates, predators, or prey. There is some potential that noise could disrupt a species' ability to communicate or interfere with behavioral patterns (Manci *et al*. 1988). Although the effects are likely temporal, aircraft noise may cause masking of auditory signals within exposed faunal communities. Animals rely on hearing to avoid predators, obtain food, and communicate and attract other members of their species. Aircraft noise may mask or interfere with these functions. Other primary effects, such as ear drum rupture or temporary and permanent hearing threshold shifts, are not as likely given the subsonic noise levels produced by aircraft overflights. Secondary effects may include non-auditory effects such as stress and hypertension; behavioral modifications; interference with mating or reproduction; and impaired ability to obtain adequate food, cover, or water. Tertiary effects are the direct result of primary and secondary effects. These include population decline and habitat loss. Most of the effects of noise are mild enough to be undetectable as variables of change in population size or population growth against the background of normal variation (Bowles 1995). Other environmental variables (e.g., predators, weather, changing prey base, ground-based disturbance) also influence secondary and tertiary effects and confound the ability to identify the ultimate factor in limiting productivity of a certain nest, area, or region (Smith *et al*. 1988). Overall, the literature suggests that species differ in their response to various types, durations, and sources of noise (Manci *et al*. 1988).

Many scientific studies have investigated the effects of aircraft noise on wildlife, and some have focused on wildlife "flight" due to noise. Apparently, animal responses to aircraft are influenced by many variables, including size, speed, proximity (both height above the ground and lateral distance), engine noise, color, flight profile, and radiated noise. The type of aircraft (e.g., fixed wing versus rotor-wing [helicopter]) and type of flight mission may also produce different levels of disturbance, with varying animal responses (Smith *et al*. 1988). Consequently, it is difficult to generalize animal responses to noise disturbances across species.

One result of the 1988 Manci *et al*. literature review was the conclusion that, while behavioral observation studies were relatively limited, a general behavioral reaction in animals from exposure to aircraft noise is the startle response. The intensity and duration of the startle response appears to be dependent on which species is exposed, whether there is a group or an individual, and whether there have been previous exposures. Responses range from flight, trampling, stampeding, jumping, or running to movement of the head in the apparent direction of the noise source. Manci *et al*. reported that the literature indicated that avian species may be more sensitive to aircraft noise than mammals (1988).

B.3.8.1 Domestic Animals

Although some studies report that the effects of aircraft noise on domestic animals is inconclusive, a majority of the literature reviewed indicates that domestic animals exhibit some behavioral responses to military overflights, but generally seem to habituate to the disturbances over a period of time. Mammals in particular appear to react to noise at sound levels higher than 90 dB, with responses including the startle response, freezing (i.e., becoming temporarily stationary), and fleeing from the sound source. Many studies on domestic animals suggest that some species appear to acclimate to some forms of sound disturbance (Manci *et al*. 1988). Some studies have reported primary and secondary effects including reduced milk production and rate of milk release, increased glucose concentrations, decreased levels of hemoglobin, increased heart rate, and a reduction in thyroid activity. These latter effects appear to represent a small percentage of the findings occurring in the existing literature.

Some reviewers have indicated that earlier studies and claims by farmers linking adverse effects of aircraft noise on livestock did not necessarily provide clear-cut evidence of cause and effect (Cottereau 1978). In contrast, many studies conclude that there is no evidence that aircraft overflights affect feed intake, growth, or production rates in domestic animals.

Cattle

In response to concerns about overflight effects on pregnant cattle, milk production, and cattle safety, the U.S. Air Force prepared a handbook for environmental protection that summarizes the literature on the impacts of low-altitude flights on livestock (and poultry), and includes specific case studies conducted in numerous airspaces across the country. Adverse effects have been found in a few studies, but have not been reproduced in other similar studies. One such study, conducted in 1983, suggested that 2 of 10 cows in late pregnancy aborted after showing rising estrogen and falling progesterone levels. These increased hormonal levels were reported as being linked to 59 aircraft overflights. The remaining eight cows showed no changes in their blood concentrations and calved normally (U.S. Air Force 1994b). A similar study reported that abortions occurred in three out of five pregnant cattle after exposing them to flyovers by six different aircraft (U.S. Air Force 1994b). Another study suggested that feedlot cattle could stampede and injure themselves when exposed to low-level overflights (U.S. Air Force 1994b).

A majority of the studies reviewed suggest that there is little or no effect of aircraft noise on cattle. Studies presenting adverse effects on domestic animals have been limited. A number of studies (Parker and Bayley 1960; Casady and Lehmann 1967; Kovalcik and Sottnik 1971) investigated the effects of jet aircraft noise and sonic booms on the milk production of dairy cows. Through the compilation and examination of milk production data from areas exposed to jet aircraft noise and sonic boom events, it was determined that milk yields were not affected. This was particularly evident in those cows that had been previously exposed to jet aircraft noise.

One study examined the causes of 1,763 abortions in Wisconsin dairy cattle over a one-year time period, and none were associated with aircraft disturbances (U.S. Air Force 1993). In 1987, Anderson contacted seven livestock operators for production data, and no effects of low-altitude and supersonic flights were noted. Three out of 43 cattle previously exposed to low-altitude flights showed a startle response to an FA-18 aircraft flying overhead at 500 feet above ground level at 400 knots by running less than 10 meters. They resumed normal activity within one minute (U.S. Air Force 1994b). In 1983, Beyer found that helicopters caused more reaction than other low-aircraft overflights. A 1964 study also found that helicopters flying 30 to 60 feet overhead did not affect milk production and pregnancies of 44 cows and heifers (U.S. Air Force 1994b).

Additionally, Beyer reported that five pregnant dairy cows in a pasture did not exhibit fright-flight tendencies or have their pregnancies disrupted after being overflown by 79 low-altitude helicopter flights and 4 low-altitude, subsonic jet aircraft flights (U.S. Air Force 1994b). A 1956 study found that the reactions of dairy and beef cattle to noise from low-altitude, subsonic aircraft were similar to those caused by paper blowing about, strange persons, or other moving objects (U.S. Air Force 1994b).

In a report to Congress, the U. S. Forest Service concluded that “evidence both from field studies of wild ungulates and laboratory studies of domestic stock indicate that the risks of damage are small (from aircraft approaches of 50 to 100 meters), as animals take care not to damage themselves (U.S. Forest Service 1992). If animals are overflown by aircraft at altitudes of 50 to 100 meters, there is no evidence that mothers and young are separated, that animals collide with obstructions (unless confined) or that they traverse dangerous ground at too high a rate.” These varied study results suggest that, although the confining of cattle could magnify animal response to aircraft overflight, there is no proven cause-and-effect link between startling cattle from aircraft overflights and abortion rates or lower milk production.

Horses

Horses have also been observed to react to overflights of jet aircraft. Several of the studies reviewed reported a varied response of horses to low-altitude aircraft overflights. Observations made in 1966 and 1968 noted that horses galloped in response to jet flyovers (U.S. Air Force 1993). In 1995, Bowles cites Kruger and Erath as observing horses exhibiting intensive flight reactions, random movements, and biting/kicking behavior. However, no injuries or abortions occurred, and there was evidence that the mares adapted somewhat to the flyovers over the course of a month (U.S. Air Force 1994b). Although horses were observed noticing the overflights, it did not appear to affect either survivability or reproductive success. There was also some indication that habituation to these types of disturbances was occurring.

LeBlanc *et al*. studied the effects of F-14 jet aircraft noise on pregnant mares (1991). They specifically focused on any changes in pregnancy success, behavior, cardiac function, hormonal production, and rate of habituation. Their findings reported observations of “flight-fright” reactions, which caused increases in heart rates and serum cortisol concentrations. The mares, however, did habituate to the noise. Levels of anxiety and mass body movements were the highest after initial exposure, with intensities of responses decreasing thereafter. There were no differences in pregnancy success when compared to a control group.

Swine

Generally, the literature findings for swine appear to be similar to those reported for cows and horses. While there are some effects from aircraft noise reported in the literature, these effects are minor. Studies of continuous noise exposure (i.e., 6 hours or 72 hours of constant exposure) reported influences on short-term hormonal production and release. Additional constant exposure studies indicated the observation of stress reactions, hypertension, and electrolyte imbalances (Dufour 1980). A study by Bond *et al*. demonstrated no adverse effects on the feeding efficiency, weight gain, ear physiology, or thyroid and adrenal gland condition of pigs subjected to aircraft noise (1963). Observations of heart rate increase were recorded and it was noted that cessation of the noise resulted in the return to normal heart rates. Conception rates and offspring survivorship did not appear to be influenced by exposure to aircraft noise.

Similarly, simulated aircraft noise at levels of 100 dB to 135 dB had only minor effects on the rate of feed utilization, weight gain, food intake, and reproduction rates of boars and sows exposed, and there were no injuries or inner ear changes observed (Manci *et al*. 1988; Gladwin *et al*. 1988).

Domestic Fowl

According to a 1994 position paper by the U.S. Air Force on effects of low-altitude overflights (below 1,000 feet) on domestic fowl, overflight activity has negligible effects (U.S. Air Force 1994a). The paper did recognize that given certain circumstances, adverse effects can be serious. Some of the effects can be panic reactions, reduced productivity, and effects on marketability (e.g., bruising of the meat caused during “pile-up” situations).

The typical reaction of domestic fowl after exposure to sudden, intense noise is a short-term startle response. The reaction ceases as soon as the stimulus is ended, and within a few minutes all activity returns to normal. More severe responses are possible depending on the number of birds, the frequency of exposure, and environmental conditions. Large crowds of birds and birds not previously exposed are more likely to pile up in response to a noise stimulus (U.S. Air Force 1994a). According to studies and interviews with growers, it is typically the previously unexposed birds that incite panic crowding, and the tendency to do so is markedly reduced within five exposures to the stimulus (U.S. Air Force 1994a). This suggests that the birds habituate relatively quickly. Egg productivity was not adversely affected by infrequent noise bursts, even at exposure levels as high as 120 to 130 dBA.

Between 1956 and 1988, there were 100 recorded claims against the Navy for alleged damage to domestic fowl. The number of claims averaged three per year, with peak numbers of claims following publications of studies on the topic in the early 1960s (U.S. Air Force 1994a). Many of the claims were disproved or did not have sufficient supporting evidence. The claims were filed for the following alleged damages: 55 percent for panic reactions, 31 percent for decreased production, 6 percent for reduced hatchability, 6 percent for weight loss, and less than 1 percent for reduced fertility (U.S. Air Force 1994a).

Turkeys

The review of the existing literature suggests that there has not been a concerted or widespread effort to study the effects of aircraft noise on commercial turkeys. One study involving turkeys examined the differences between simulated versus actual overflight aircraft noise, turkey responses to the noise, weight gain, and evidence of habituation (Bowles *et al*. 1990a). Findings from the study suggested that turkeys habituated to jet aircraft noise quickly, that there were no growth rate differences between the experimental and control groups, and that there were some behavioral differences that increased the difficulty in handling individuals within the experimental group.

Low-altitude overflights were shown to cause turkey flocks which were kept inside turkey houses to occasionally pile up and experience high mortality rates due to the aircraft noise and a variety of disturbances unrelated to aircraft (U.S. Air Force 1994a).

B.3.8.2 Wildlife

Studies on the effects of overflights and sonic booms on wildlife have been focused mostly on avian species and ungulates such as caribou and bighorn sheep. Few studies have been conducted on marine mammals, small terrestrial mammals, reptiles, amphibians, and carnivorous mammals. Generally, species that live entirely below the surface of the water have also been ignored due to the fact they do not experience the same level of sound as terrestrial species (National Park Service 1994). Wild ungulates appear to be much more sensitive to noise disturbance than domestic livestock (Manci *et al*. 1988). This may be due to previous exposure to disturbances. One common factor appears to be that low-altitude flyovers seem to be more disruptive in terrain where there is little cover (Manci *et al*. 1988).

B.3.8.2.1 Mammals

Terrestrial Mammals

Studies of terrestrial mammals have shown that noise levels of 120 dBA can damage mammals' ears, and levels of 95 dBA can cause temporary loss of hearing acuity. Noise from aircraft has affected other large carnivores by causing changes in home ranges, foraging patterns, and breeding behavior. One study recommended that aircraft not be allowed to fly at altitudes below 2,000 feet above ground level over important grizzly and polar bear habitat (Dufour 1980). Wolves have been frightened by low-altitude flights that were 25 to 1,000 feet off the ground. However, wolves have been found to adapt to aircraft overflights and noise as long as they were not being hunted from aircraft (Dufour 1980).

Wild ungulates (American bison, caribou, bighorn sheep) appear to be much more sensitive to noise disturbance than domestic livestock (Weisenberger *et al*. 1996). Behavioral reactions may be related to the past history of disturbances by such things as humans and aircraft. Common reactions of reindeer kept in an enclosure and exposed to aircraft noise disturbance were a slight startle response, raising of the head, pricking ears, and scenting of the air. Panic reactions and extensive changes in behavior of individual animals were not observed. Observations of caribou in Alaska exposed to fixed-wing aircraft and helicopters showed running and panic reactions occurred when overflights were at an altitude of 200 feet or less. The reactions decreased with increased altitude of overflights, and for overflights higher than 500 feet in altitude, the panic reactions stopped. Also, smaller groups reacted less strongly than larger groups. One negative effect of the running and avoidance behavior is increased expenditure of energy. For a 90-kilogram animal, the calculated expenditure due to aircraft harassment is 64 kilocalories per minute when running and 20 kilocalories per minute when walking. When conditions are favorable, this expenditure can be counteracted with increased feeding; however, during harsh winter conditions, this may not be possible. Incidental observations of wolves and bears exposed to fixed-wing aircraft and helicopters suggested that wolves were less disturbed than wild ungulates, while grizzly bears showed the greatest response of any animal species observed.

It has been proven that low-altitude overflights do induce stress in animals. Increased heart rates, an indicator of excitement or stress, have been found in pronghorn antelope, elk, and bighorn sheep. These reactions occur naturally as a response to predation, so infrequent overflights may not, in and of themselves, be detrimental. However, flights at high frequencies over a long period of time may cause harmful effects. The consequences of this disturbance, while cumulative, are not additive. Aircraft disturbance may not cause obvious and serious health effects, but coupled with a harsh winter, it may have an adverse impact. Research has shown that stress induced by other types of disturbances produces long-term decreases in metabolism and hormone balances in wild ungulates.

Behavioral responses can range from mild to severe. Mild responses include head raising, body shifting, or turning to orient toward the aircraft. Moderate disturbance may be nervous behaviors, such as trotting a short distance. Escape is the typical severe response.

Marine Mammals

The physiological composition of the ear in aquatic and marine mammals exhibits adaptation to the aqueous environment. These differences (relative to terrestrial species) manifest themselves in the auricle and middle ear (Manci *et al*. 1988). Some mammals use echolocation to perceive objects in their surroundings and to determine the directions and locations of sound sources (Simmons 1983 in Manci *et al*. 1988).

In 1980, the Acoustical Society of America held a workshop to assess the potential hazard of manmade noise associated with proposed Alaskan Arctic (North Slope-Outer Continental Shelf) petroleum operations on marine wildlife, and to prepare a research plan to secure the knowledge necessary for proper assessment of noise impacts (Acoustical Society of America 1980). Since 1980, it appears that research on the responses of aquatic mammals to aircraft noise and sonic booms has been limited. Research conducted on northern fur seals, sea lions, and ringed seals indicated that there are some differences in how various animal groups receive frequencies of sound. It was observed that these species exhibited varying intensities of a startle response to airborne noise, which was habituated over time. The rates of habituation appeared to vary with species, populations, and demographics (age, sex). Time of day of exposure was also a factor (Muyberg 1978 in Manci *et al*. 1988).

Studies accomplished near the Channel Islands were conducted near the area where the space shuttle launches occur. It was found that there were some response differences between species relative to the loudness of sonic booms. Those booms that were between 80 and 89 dBA caused a greater intensity of startle reactions than lower-intensity booms at 72 to 79 dBA. However, the duration of the startle responses to louder sonic booms was shorter (Jehl and Cooper 1980 in Manci *et al*. 1988).

Jehl and Cooper indicated that low-flying helicopters, loud boat noises, and humans were the most disturbing to pinnipeds (1980). According to the research, although the space launch and associated operational activity noises have not had a measurable effect on the pinniped population, it also suggests that there was a greater “disturbance level” exhibited during launch activities. There was a recommendation to continue observations for behavioral effects and to perform long-term population monitoring (Jehl and Cooper 1980).

The continued presence of single or multiple noise sources could cause marine mammals to leave a preferred habitat. However, it does not appear likely that overflights could cause migration from suitable habitats because aircraft noise over water is mobile and would not persist over any particular area. Aircraft noise, including supersonic noise, currently occurs in the overwater airspace of Eglin, Tyndall, and Langley Air Force Bases (AFBs) from sorties predominantly involving jet aircraft. Survey results reported in Davis *et al*. indicate that cetaceans (i.e., dolphins) occur under all of the Eglin and Tyndall marine airspace (2000). The continuing presence of dolphins indicates that aircraft noise does not discourage use of the area and apparently does not harm the locally occurring population.

In a summary by the National Parks Service on the effects of noise on marine mammals, it was determined that gray whales and harbor porpoises showed no outward behavioral response to aircraft noise or overflights (1994). Bottlenose dolphins showed no obvious reaction in a study involving helicopter overflights at 1,200 to 1,800 feet above the water. They also did not show any reaction to survey aircraft unless the shadow of the aircraft passed over them, at which point there was some observed tendency to dive (Richardson *et al*. 1995). Other anthropogenic noises in the marine environment from ships and pleasure craft may have more of an effect on marine mammals than aircraft noise (U.S. Air Force 2000). The noise effects on cetaceans appear to be somewhat attenuated by the air/water interface. The cetacean fauna along the coast of California have been subjected to sonic booms from military aircraft for many years without apparent adverse effects (Tetra Tech Inc. 1997).

Manatees appear relatively unresponsive to human-generated noise to the point that they are often suspected of being deaf to oncoming boats (although their hearing is actually similar to that of pinnipeds) (Bullock, *et al*. 1980). Little is known about the importance of acoustic communication to manatees, although they are known to produce at least ten different types of sounds and are thought to have sensitive hearing (Richardson *et al*. 1995). Manatees continue to occupy canals near Miami International Airport, which suggests that they have become habituated to human disturbance and noise (Metro-Dade County 1995). Manatees spend most of their time below the surface and do not startle readily, so no effect of aircraft overflights on manatees would be expected (Bowles *et al*. 1991b).

B.3.8.2.2 Birds

Auditory research conducted on birds indicates that they fall between reptiles and mammals relative to hearing sensitivity. According to Dooling, within the range of 1,000 to 5,000 Hz, birds show a level of hearing sensitivity similar to that of the more sensitive mammals (1978). In contrast to mammals, bird sensitivity falls off at a greater rate with increasing and decreasing frequencies. Passive observations and studies examining aircraft bird strikes indicate that birds nest and forage near airports. Aircraft noise in the vicinity of commercial airports apparently does not inhibit bird presence and use.

High-noise events (like a low-altitude aircraft overflight) may cause birds to engage in escape or avoidance behaviors, such as flushing from perches or nests (Ellis *et al*. 1991). These activities impose an energy cost on the birds that, over the long term, may affect survival or growth. In addition, the birds may spend less time engaged in necessary activities like feeding, preening, or caring for their young because they spend time in noise-avoidance activity. However, the long-term significance of noise-related impacts is less clear. Several studies on nesting raptors have indicated that birds become habituated to aircraft overflights and that long-term reproductive success is not affected (Grubb and King 1991; Ellis *et al*. 1991). Threshold noise levels for significant responses range from 62 dB for Pacific black brant to 85 dB for crested tern (Ward and Stehn 1990; Brown 1990).

Songbirds were observed to become silent prior to the onset of a sonic boom event (F-111 jets), followed by “raucous discordant cries.” There was a return to normal singing within 10 seconds after the boom (Higgins 1974 in Manci *et al*. 1988). Ravens responded by emitting protestation calls, flapping their wings, and soaring.

Manci *et al*. reported a reduction in reproductive success in some small territorial passerines (i.e., perching birds or songbirds) after exposure to low-altitude overflights (1988). However, it has been observed that passerines are not driven any great distance from a favored food source by a nonspecific disturbance, such as aircraft overflights (U.S. Forest Service 1992). Further study may be warranted.

A recent study, conducted cooperatively between the DoD and the U.S. Fish and Wildlife Serve (USFWS), assessed the response of the red-cockaded woodpecker to a range of military training noise events, including artillery, small arms, helicopter, and maneuver noise (Pater *et al*. 1999). The project findings show that the red-cockaded woodpecker successfully acclimates to military noise events. Depending on the noise level, which ranged from innocuous to very loud, the birds responded by flushing from their nest cavities. When the noise source was closer and the noise level was higher, the number of flushes increased proportionately. In all cases, however, the birds returned to their nests within a relatively short period of time (usually within 12 minutes). Additionally, the noise exposure did not result in any mortality or statistically detectable changes in reproductive success (Pater *et al*. 1999). Red-cockaded woodpeckers did not flush when artillery simulators were more than 122 meters away and SEL noise levels were 70 dBA.

Lynch and Speake studied the effects of both real and simulated sonic booms on the nesting and brooding eastern wild turkey in Alabama (1978). Hens at four nest sites were subjected to between 8 and 11 combined real and simulated sonic booms. All tests elicited similar responses, including quick lifting of the head and apparent alertness for between 10 and 20 seconds. No apparent nest failure occurred as a result of the sonic booms.

Twenty-one brood groups were also subjected to simulated sonic booms. Reactions varied slightly between groups, but the largest percentage of groups reacted by standing motionless after the initial blast. Upon the sound of the boom, the hens and poults fled until reaching the edge of the woods (approximately 4 to 8 meters). Afterward, the poults resumed feeding activities while the hens remained alert for a short period of time (approximately 15 to 20 seconds). In no instances were poults abandoned, nor did they scatter and become lost. Every observation group returned to normal activities within a maximum of 30 seconds after a blast.

B.3.8.2.3 Raptors

In a literature review of raptor responses to aircraft noise, Manci *et al*. found that most raptors did not show a negative response to overflights (1988). When negative responses were observed they were predominantly associated with rotor-winged aircraft or jet aircraft that were repeatedly passing within 0.5 mile of a nest.

Ellis *et al*. performed a study to estimate the effects of low-level military jet aircraft and mid-to high-altitude sonic booms (both actual and simulated) on nesting peregrine falcons and seven other raptors (common black-hawk, Harris' hawk, zone-tailed hawk, red-tailed hawk, golden eagle, prairie falcon, bald eagle) (1991). They observed responses to test stimuli, determined nest success for the year of the testing, and evaluated site occupancy the following year. Both long- and short-term effects were noted in the study. The results reported the successful fledging of young in 34 of 38 nest sites (all eight species) subjected to low-level flight and/or simulated sonic booms. Twenty-two of the test sites were revisited in the following year, and observations of pairs or lone birds were made at all but one nest. Nesting attempts were underway at 19 of 20 sites that were observed long enough to be certain of breeding activity. Re-occupancy and productivity rates were within or above expected values for self-sustaining populations.

Short-term behavior responses were also noted. Overflights at a distance of 150 meters or less produced few significant responses and no severe responses. Typical responses included crouching or, very rarely, flushing from the perch site. Significant responses were most evident before egg laying and after young were "well grown." Incubating or brooding adults never burst from the nest, thus preventing egg breaking or knocking chicks out of the nest. Jet passes and sonic booms often caused noticeable alarm; however, significant negative responses were rare and did not appear to limit productivity or re-occupancy. The locations of some of the nests may have caused some birds to be habituated to aircraft noise. There were some test sites located at distances far from zones of frequent military aircraft usage, and the test stimuli were often closer, louder, and more frequent than would be likely for a normal training situation.

Manci *et al*. noted that a female northern harrier was observed hunting on a bombing range in Mississippi during bombing exercises (1988). The harrier was apparently unfazed by the exercises, even when a bomb exploded within 200 feet. In a similar case of habituation/non-disturbance, a study on the Florida snail-kite stated that the greatest reaction to overflights (approximately 98 dBA) was "watching the aircraft fly by." No detrimental impacts to distribution, breeding success, or behavior were noted.

Bald Eagle

A study by Grubb and King on the reactions of the bald eagle to human disturbances showed that terrestrial disturbances elicited the greatest response, followed by aquatic (i.e., boats) and aerial disturbances (1991). The disturbance regime of the area where the study occurred was predominantly characterized by aircraft noise. The study found that pedestrians consistently caused responses that were greater in both frequency and duration. Helicopters elicited the highest level of aircraft-related responses. Aircraft disturbances, although the most common form of disturbance, resulted in the lowest levels of response. This low response level may have been due to habituation; however, flights less than 170 meters away caused reactions similar to other disturbance types. Ellis *et al*. showed that eagles typically respond to the proximity of a disturbance, such as a pedestrian or aircraft within 100 meters, rather than the noise level (1991). Fleischner and Weisberg stated that reactions of bald eagles to commercial jet flights, although minor (e.g., looking), were twice as likely to occur when the jets passed at a distance of 0.5 mile or less (1986). They also noted that helicopters were four times more likely to cause a reaction than a commercial jet and 20 times more likely to cause a reaction than a propeller plane. The USFWS advised Cannon AFB that flights at or below 2,000 feet above ground level from October 1 through March 1 could result in adverse impacts to wintering bald eagles (USFWS 1998). However, Fraser *et al*. suggested that raptors habituate to overflights rapidly, sometimes tolerating aircraft approaches of 65 feet or less (1985).

Osprey

A 1998 study by Trimper *et al*. in Goose Bay, Labrador, Canada focused on the reactions of nesting osprey to military overflights by CF-18 Hornets. Reactions varied from increased alertness and focused observation of planes to adjustments in incubation posture. No overt reactions (e.g., startle response, rapid nest departure) were observed as a result of an overflight. Young nestlings crouched as a result of any disturbance until they grew to 1 to 2 weeks prior to fledging. Helicopters, human presence, float planes, and other ospreys elicited the strongest reactions from nesting ospreys. These responses included flushing, agitation, and aggressive displays. Adult osprey showed high nest occupancy rates during incubation regardless of external influences.

The osprey observed occasionally stared in the direction of the flight before it was audible to the observers. The birds may have been habituated to the noise of the flights; however, overflights were strictly controlled during the experimental period. Strong reactions to float planes and helicopter may have been due to the slower flight and therefore longer duration of visual stimuli rather than noise-related stimuli.

Red-tailed Hawk

Anderson *et al*. conducted a study that investigated the effects of low-level helicopter overflights on 35 red-tailed hawk nests (1989). Some of the nests had not been flown over prior to the study. The hawks that were naïve (i.e., not previously exposed) to helicopter flights exhibited stronger avoidance behavior (nine of 17 birds flushed from their nests) than those that had experienced prior overflights. The overflights did not appear to affect nesting success in either study group. These findings were consistent with the belief that red-tailed hawks habituate to low-level air traffic, even during the nesting period.

B.3.8.2.4 Migratory Waterfowl

A study of caged American black ducks was conducted by Fleming *et al*. in 1996. It was determined that noise had negligible energetic and physiologic effects on adult waterfowl. Measurements included body weight, behavior, heart rate, and enzymatic activity. Experiments also showed that adult ducks exposed to high noise events acclimated rapidly and showed no effects.

The study also investigated the reproductive success of captive ducks, which indicated that duckling growth and survival rates at Piney Island, North Carolina were lower than those at a background location. In contrast, observations of several other reproductive indices (i.e., pair formation, nesting, egg production, and hatching success) showed no difference between Piney Island and the background location. Potential effects on wild duck populations may vary, as wild ducks at Piney Island have presumably acclimated to aircraft overflights. It was not demonstrated that noise was the cause of adverse impacts. A variety of other factors, such as weather conditions, drinking water and food availability and variability, disease, and natural variability in reproduction, could explain the observed effects. Fleming noted that drinking water conditions (particularly at Piney Island) deteriorated during the study, which could have affected the growth of young ducks. Further research would be necessary to determine the cause of any reproductive effects.

Another study by Conomy *et al*. exposed previously unexposed ducks to 71 noise events per day that equaled or exceeded 80 dBA (1998). It was determined that the proportion of time black ducks reacted to aircraft activity and noise decreased from 38 percent to 6 percent in 17 days and remained stable at 5.8 percent thereafter. In the same study, the wood duck did not appear to habituate to aircraft disturbance. This supports the notion that animal response to aircraft noise is species-specific. Because a startle response to aircraft noise can result in flushing from nests, migrants and animals living in areas with high concentrations of predators would be the most vulnerable to experiencing effects of lowered birth rates and recruitment over time. Species that are subjected to infrequent overflights do not appear to habituate to overflight disturbance as readily.

Black brant studied in the Alaskan Peninsula were exposed to jets and propeller aircraft, helicopters, gunshots, people, boats, and various raptors. Jets accounted for 65 percent of all the disturbances. Humans, eagles, and boats caused a greater percentage of brant to take flight. There was markedly greater reaction to Bell-206-B helicopter flights than fixed wing, single-engine aircraft (Ward *et al*. 1986).

The presence of humans and low-flying helicopters in the Mackenzie Valley North Slope area did not appear to affect the population density of Lapland longspurs, but the experimental group was shown to have reduced hatching and fledging success and higher nest abandonment. Human presence appeared to have a greater impact on the incubating behavior of the black brant, common eider, and Arctic tern than fixed-wing aircraft (Gunn and Livingston 1974).

Gunn and Livingston found that waterfowl and seabirds in the Mackenzie Valley and North Slope of Alaska and Canada became acclimated to float plane disturbance over the course of three days (1974). Additionally, it was observed that potential predators (bald eagle) caused a number of birds to leave their nests. Non-breeding birds were observed to be more reactive than breeding birds. Waterfowl were affected by helicopter flights, while snow geese were disturbed by Cessna 185 flights. The geese flushed when the planes were under 1,000 feet, compared to higher flight elevations. An overall reduction in flock sizes was observed. It was recommended that aircraft flights be reduced in the vicinity of pre-migratory staging areas.

Manci *et al*. reported that waterfowl were particularly disturbed by aircraft noise (1988). The most sensitive appeared to be snow geese. Canada geese and snow geese were thought to be more sensitive than other animals such as turkey vultures, coyotes, and raptors (Edwards *et al*. 1979).

B.3.8.2.5 Wading and Shore Birds

Black *et al*. studied the effects of low-altitude (less than 500 feet above ground level) military training flights with sound levels from 55 to 100 dBA on wading bird colonies (i.e., great egret, snowy egret, tricolored heron, and little blue heron) (1984). The training flights involved three or four aircraft, which occurred once or twice per day. This study concluded that the reproductive activity--including nest success, nestling survival, and nestling chronology--was independent of F-16 overflights. Dependent variables were more strongly related to ecological factors, including location and physical characteristics of the colony and climatology. Another study on the effects of circling fixed-wing aircraft and helicopter overflights on wading bird colonies found that at altitudes of 195 to 390 feet, there was no reaction in nearly 75 percent of the 220 observations. Ninety percent displayed no reaction or merely looked toward the direction of the noise source. Another 6 percent stood up, 3 percent walked from the nest, and 2 percent flushed (but were without active nests) and returned within 5 minutes (Kushlan 1978). Apparently, non-nesting wading birds had a slightly higher incidence of reacting to overflights than nesting birds. Seagulls observed roosting near a colony of wading birds in another study remained at their roosts when subsonic aircraft flew overhead (Burger 1981). Colony distribution appeared to be most directly correlated to available wetland community types and was found to be distributed randomly with respect to military training routes. These results suggest that wading bird species presence was most closely linked to habitat availability and that they were not affected by low-level military overflights (U.S. Air Force 2000).

Burger studied the response of migrating shorebirds to human disturbance and found that shorebirds did not fly in response to aircraft overflights, but did flush in response to more localized intrusions (i.e., humans and dogs on the beach) (1986). Burger studied the effects of noise from JFK Airport in New York on herring gulls that nested less than 1 kilometer from the airport (1981). Noise levels over the nesting colony were 85 to 100 dBA on approach and 94 to 105 dBA on takeoff. Generally, there did not appear to be any prominent adverse effects of subsonic aircraft on nesting, although some birds flushed when a Concorde flew overhead and, when they returned, engaged in aggressive behavior. Groups of gulls tended to loaf in the area of the nesting colony, and these birds remained at the roost when the Concorde flew overhead. Up to 208 of the loafing gulls flew when supersonic aircraft flew overhead. These birds would circle around and immediately land in the loafing flock (U.S. Air Force 2000).

In 1970, sonic booms were potentially linked to a mass hatch failure of Sooty Terns on the Dry Tortugas (Austin *et al*. 1970). The cause of the failure was not certain, but it was conjectured that sonic booms from military aircraft or an overgrowth of vegetation were factors. In the previous season, Sooties were observed to react to sonic booms by rising in a "panic flight," circling over the island, and then usually settling down on their eggs again. Hatching that year was normal. Following the 1969 hatch failure, excess vegetation was cleared and measures were taken to reduce supersonic activity. The 1970 hatch appeared to proceed normally. A colony of Noddies on the same island hatched successfully in 1969, the year of the Sooty hatch failure.

Subsequent laboratory tests of exposure of eggs to sonic booms and other impulsive noises (Bowles *et al.* 1991a; Bowles *et al*. 1994; Cottereau 1972; Cogger and Zegarra 1980) failed to show adverse effects on the hatching of eggs. A structural analysis (Ting *et al*. 2002) showed that, even under extraordinary circumstances, sonic booms would not damage an avian egg.

Burger observed no effects of subsonic aircraft on herring gulls in the vicinity of JFK International Airport (1981). The Concorde aircraft did cause more nesting gulls to leave their nests (especially in areas of higher density of nests), causing the breakage of eggs and the scavenging of eggs by intruder prey. Clutch sizes were observed to be smaller in areas of higher-density nesting (presumably due to the greater tendency for panic flight) than in areas where there were fewer nests.

B.3.8.3 Fish, Reptiles, and Amphibians

The effects of overflight noise on fish, reptiles, and amphibians have been poorly studied, but conclusions regarding their expected responses have involved speculation based upon known physiologies and behavioral traits of these taxa (Gladwin *et al*. 1988). Although fish do startle in response to low-flying aircraft noise, and probably to the shadows of aircraft, they have been found to habituate to the sound and overflights. Reptiles and amphibians that respond to low frequencies and those that respond to ground vibration, such as spadefoots (genus Scaphiopus), may be affected by noise. Limited information is available on the effects of short-duration noise events on reptiles. Dufour in 1980 and Manci *et al*. in 1988, summarized a few studies of reptile responses to noise. Some reptile species tested under laboratory conditions experienced at least temporary threshold shifts or hearing loss after exposure to 95 dB for several minutes. Crocodilians in general have the most highly developed hearing of all reptiles. Crocodile ears have lids that can be closed when the animal goes under water. These lids can reduce the noise intensity by 10 to 12 dB (Wever and Vernon 1957). On Homestead Air Reserve Station, Florida, two crocodilians (the American Alligator and the Spectacled Caiman) reside in wetlands and canals along the base runway suggesting that they can coexist with existing noise levels of an active runway including DNLs of 85 dB.

B.3.8.4 Summary

Some physiological/behavioral responses such as increased hormonal production, increased heart rate, and reduction in milk production have been described in a small percentage of studies. A majority of the studies focusing on these types of effects have reported short-term or no effects.

The relationships between physiological effects and how species interact with their environments have not been thoroughly studied. Therefore, the larger ecological context issues regarding physiological effects of jet aircraft noise (if any) and resulting behavioral pattern changes are not well understood.

Animal species exhibit a wide variety of responses to noise. It is therefore difficult to generalize animal responses to noise disturbances or to draw inferences across species, as reactions to jet aircraft noise appear to be species-specific. Consequently, some animal species may be more sensitive than other species and/or may exhibit different forms or intensities of behavioral responses. For instance one study suggests that wood ducks appear to be more sensitive and more resistant to acclimation to jet aircraft noise than Canada geese. Similarly, wild ungulates seem to be more easily disturbed than domestic animals.

The literature does suggest that common responses include the "startle" or "fright" response and, ultimately, habituation. It has been reported that the intensities and durations of the startle response decrease with the numbers and frequencies of exposures, suggesting no long-term adverse effects. The majority of the literature suggests that domestic animal species (cows, horses, chickens) and wildlife species exhibit adaptation, acclimation, and habituation after repeated exposure to jet aircraft noise and sonic booms.

Animal responses to aircraft noise appear to be somewhat dependent on, or influenced by, the size, shape, speed, proximity (vertical and horizontal), engine noise, color, and flight profile of planes. Helicopters also appear to induce greater intensities and durations of disturbance behavior as compared to fixed-wing aircraft. Some studies showed that animals that had been previously exposed to jet aircraft noise exhibited greater degrees of alarm and disturbance to other objects creating noise, such as boats, people, and objects blowing across the landscape. Other factors influencing response to jet aircraft noise may include wind direction, speed, and local air turbulence; landscape structures (i.e., amount and type of vegetative cover); and, in the case of bird species, whether the animals are in the incubation/nesting phase.

B.3.9 Property Values

Property within a noise zone (or Accident Potential Zone) may be affected by the availability of federally guaranteed loans. According to U.S. Department of Housing and Urban Development (HUD), Federal Housing Administration (FHA), and Veterans Administration (VA) guidance, sites are acceptable for program assistance, subsidy, or insurance for housing in noise zones of less than 65 dB DNL, and sites are conditionally acceptable with special approvals and noise attenuation in noise zones greater than 65 dB DNL. HUD's position is that noise is not the only determining factor for site acceptability, and properties should not be rejected only because of airport influences if there is evidence of acceptability within the market and if use of the dwelling is expected to continue. Similar to the Navy's and Air Force's Air Installation Compatible Use Zone Program, HUD, FHA, and VA recommend sound attenuation for housing in the higher noise zones and written disclosures to all prospective buyers or lessees of property within a noise zone (or Accident Potential Zone).

Newman and Beattie reviewed the literature to assess the effect of aircraft noise on property values (1985). One paper by Nelson, reviewed by Newman and Beattie, suggested a 1.8 to 2.3 percent decrease in property value per dB at three separate airports, while at another period of time, they found only a 0.8 percent devaluation per dB change in DNL (1978). However, Nelson also noted a decline in noise depreciation over time which was theorized to be due to either noise sensitive people being replaced by less sensitive people or the increase in commercial value of the property near airports; both ideas were supported by Crowley (1978). Ultimately, Newman and Beattie summarized that while an effect of noise was observed, noise is only one of the many factors that is part of a decision to move close to, or away from, an airport, but which is sometimes considered an advantage due to increased opportunities for employment or ready access to the airport itself. With all the issues associated with determining property values, their reviews found that decreases in property values usually range from 0.5 to 2 percent per dB increase of cumulative noise exposure.

More recently, Fidell *et al*. studied the influences of aircraft noise on actual sale prices of residential properties in the vicinity of two military facilities, and found that equations developed for one area to predict residential sale prices in areas unaffected by aircraft noise worked equally well when applied to predicting sale prices of homes in areas with aircraft noise in excess of 65 dB DNL (1996). Thus, the model worked equally well in predicting sale prices in areas with and without aircraft noise exposure. This indicates that aircraft noise had no meaningful effect on residential property values. In some cases, the average sale prices of noise exposed properties were somewhat higher than those elsewhere in the same area. In the vicinity of Davis-Monthan AFB in Tucson, Arizona, Fidell found the homes near the AFB were much older, smaller, and in poorer condition than homes elsewhere. These factors caused the equations developed for predicting sale prices in areas further away from the base to be inapplicable with those nearer the AFB. However, similar to other researchers, Fidell found that differences in sale prices between homes with and without aircraft noise were frequently due to factors other than noise itself.

B.3.10 Noise Effects on Structures

Normally, the most sensitive components of a structure to airborne noise are the windows and, infrequently, the plastered walls and ceilings. An evaluation of the peak sound pressures impinging on the structure is normally used to determine the possibility of damage. In general, with peak sound levels above 130 dB, there is the possibility of the excitation of structural component resonances. While certain frequencies (such as 30 Hz for window breakage) may be of more concern than other frequencies, conservatively, only sounds lasting more than one second above a sound level of 130 dB are potentially damaging to structural components (Committee on Hearing, Bioacoustics, and Biomechanics 1977).

Noise-induced structural vibration may also cause annoyance to dwelling occupants because of induced secondary vibrations or rattling of objects within the dwelling such as hanging pictures, dishes, plaques, and bric-a-brac. Window panes may also vibrate noticeably when exposed to high levels of airborne noise. In general, such noise-induced vibrations occur at peak sound levels of 110 dB or greater. Thus, assessments of noise exposure levels for compatible land use should also be protective of noise-induced secondary vibrations.

B.3.11 Noise Effects on Terrain

It has been suggested that noise levels associated with low-flying aircraft may affect the terrain under the flight path by disturbing fragile soil or snow, especially in mountainous areas, causing landslides or avalanches. There are no known instances of such effects, and it is considered improbable that such effects would result from routine, subsonic aircraft operations.

B.3.12 Noise Effects on Historical and Archaeological Sites

The potential for increased fragility of structural components of historical buildings and other historical sites could cause aircraft noise to affect such sites more severely than newer, modern structures.

Particularly in older structures, seemingly insignificant surface cracks initiated by vibrations from aircraft noise may lead to greater damage from natural forces (Hanson *et al*. 1991). There are few scientific studies of such effects to provide guidance for their assessment.

One study involved the measurements of sound levels and structural vibration levels in a restored plantation house, originally built in 1795, and now situated approximately 1,500 feet from the centerline at the departure end of Runway 19L at Washington Dulles International Airport. These measurements were made in connection with the proposed scheduled operation of the Concorde airplane at Dulles (Wesler 1977). There was special concern for the building's windows, since roughly half of the 324 panes were original. No instances of structural damage were found. Interestingly, despite the high levels of noise during Concorde takeoffs, the induced structural vibration levels were actually less than those induced by touring groups and vacuum cleaning.

As noted above for the noise effects of noise-induced vibrations of conventional structures, assessments of noise exposure levels for normally compatible land uses should also be protective of historic and archaeological sites.

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